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FARMERS DIGEST

JULY, 1938

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The Farmer's Digest

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The Farmer's Digest

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Hayways

Condensed from Farm Journal

Keith Gordon

MEN have many different ways of putting up hay. The way that suits the New Englander (who prizes his rowen) is not quite to the liking of the Nebraskan, who pins his faith on second or third-cutting alfalfa. But who will say that one can not profit from methods used by the other?

The "speediest way to put up hay," is what J. Leo Ahart, Crawford county, Iowa (field-stacking territory), claims for his hayway, which makes use of sweep rakes and overshot stacker to build round stacks, which, says he, are best for these reasons:

Sweep Rake, Round Stack, Overshot Stacker

1. Load falls in stack center, making center solid. 2. One man can handle hay from two sweeps. 3. Easy to keep all hay on stack. 4. If wind changes, stacker can be moved to any side. 5. More room for stacker team, no interference with stacker rope. 6. Less stack surface to weather. 7. Round stack settles compactly. 8. Round stack is streamlined, weighted hangers not necessary.

Summing it all up, Ahart says: "We get such good hay out of round stacks, with so little spoilage, we prefer field stacking to mowing away in the barn."

His secret of efficiency in using sweep rakes is to have the two rakes alternate their near and far loadings, so as to keep everybody busy and not crowd the man on the stack. A tractor buckrake, for him, does the work of two horse sweep rakes. He uses truck or car for hoisting—in reverse, so the driver can see what he is doing.

Ahart's overshot stacker is adjustable for height discharge, arms extend as the load goes up, thus giving constant load on the hoisting cable. The extended weight of the head returns the stacker even against the wind after going over dead center. Self-dump rake is preferred to side-delivery rake for field stacking,

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because it makes a larger windrow, and that means less travel with sweeps. He rakes soon after mowing, so the alfalfa cures mostly in the windrows.

A new way with alfalfa is the method used by Ray Matson on Kohler Farms, Sheboygan county, Wisconsin. He mows until eleven in the forenoon, rakes in the afternoon with side-delivery rake, starts to pick up the following morning as soon as the dew is off.

Hay is taken from the windrow with a tractor-drawn hay combine that cuts into two-inch lengths and loads the chopped hay into racks on wagons pulled along behind.

Blown into the mow, the chopped hay is stored in bins 3½ feet wide, 16 feet deep and 22 feet long. Some of the bin walls are of poultry netting, some of snow fence, and some of plaster lath spaced one inch apart on 2x4 studding. Hay comes out of these bins bright and green. The bins give the 12-ton mow 40 tons capacity.

Following Matson's example, some of the neighbors are using side-delivery rake, and silage cutter with two blades removed to chop the hay and blow it into the mow.

Leaves In, Butts Out, Better Hay

The side-delivery rake is "tops" in methods used by Louis Brenner, in handling 87 acres of alfalfa on his Monona county farm (Iowa).

Brenner's practice is to start the tractor mower in the morning as soon as most of the dew is off. About one o'clock, when the hay has started to wilt, the side-delivery rake starts around the field in the same direction as the mower. If the crop is light, windrows are doubled so that the hay loader will only need to travel half as far for a load.

In normal drying weather, the windrowed hay cures enough during the afternoon to be ready for the hay loader after most of the dew is off the following morning. If rain catches the windrowed hay, side-delivery rake turns it again so it will dry quickly.

Advantages claimed for the side-delivery rake over the dump rake are: Hay can be raked much greener, thus doing away with leaf shattering; more uniform curing is possible because leaves are inside, stems outside; hay loader does a cleaner job of picking up the side-delivery raked hay; hay can be put up a half day sooner; final result, better hay with less labor.

Pick-up baler and side-delivery rake team up together for a winning hayway on Charles Ackerman's farm, Madison county, Ohio. Ackerman farms 945 acres, makes over 500 tons of hay—alfalfa, clover and mixed, all grown in rotation with grain.

Ackerman Bales from the Windrow

After trying about every system of haymaking, Ackerman is thoroughly sold on side-delivery rake and pick-up baler. Alfalfa is cut with rubber-tired tractor pulling one or two mowers. In a few hours, or as soon as wilted, the alfalfa is side-delivery raked the same direction it is mowed. This turns the leaves inside and the butts out of the windrow so that leaves are saved, green color preserved and more uniform curing secured. With favorable weather it takes from two to two and one-half days to cure in windrow.

For the pick-up baler he lets hay dry as though it were to be stored loose in the barn.

On the day of baling the windrow is turned over to expose the lower side, and then the rubber-tired tractor pulling pick-up baler handles from three and one-half to four tons per hour.

Advantages claimed by Ackerman for the side-delivery rake and pick-up baler method are: Low cost; convenience; baled hay easier to handle; baling saves leaves and green color; a clean job of haying; baled hay sells best on the market.

Asking for a big share of the haying job and sure to get it is the molasses silage method of handling legumes and grasses. This method takes the risk of weather out of haying, provides a high-class silage, prevents all waste of stemmy portions of the hay crops.

Equipment for making silage from hay crops is much the same as for haying. The green crop is taken from the swath with a rebuilt hay loader (chains replace hayloader ropes, oak slats replace original slats). It is run through the silage cutter and blown into the silo. Molasses is added to the grass before it goes through the cutter or by pump inside the silo.

A piece of haying machinery used with satisfaction in field-stacking is the combined sweep-rake and stacker. This rig, pushed by truck or tractor, takes hay from the swath or windrow. When the sweep has gathered and elevated a load, the rig is driven to the stack and unloaded. No hoisting machinery is needed at the stack.

Chopping is the heart of the hayway used by Claude Gorham, Bradford county, Penna. He began chopping six years ago because lime, phosphate and manure had made his crop too large for his mow space. Chopping doubled his mow capacity. The haying method on Gorham's farm is as follows:

Grass is cut when free from dew or rain. Very green, heavy hay is tedded before raking. Team or truck pulls side-delivery rake to put wilted grass into small windrows which are easily

taken up by hay loader. Truck and loader pick up the hay. The hay is cured just as though it were to be put into the barn without chopping.

At the barn two men pitch the hay onto a well-braced 8 x 10-foot platform, a third man on the platform forks the hay onto the chopper feed table. The blower pipe is moved frequently to keep the hay as nearly level as possible in the mow. Chopped hay is blown clear across a 46-foot mow. Large ensilage forks are used to take the hay out.

Pioneer in Conservation

Condensed from Missouri Ruralist

Cecil Barger

SOIL conservation, the leading farm problem of the nation today, had its beginning in Missouri only 21 years ago.

A quarter of a century ago little was thought about soil erosion. A few had begun to notice the ill effects of continuous cropping of soil-depleting crops and of leaving bare ground exposed, but up to that time no studies for definite erosion data had been made.

In the spring of 1915, a graduate student in soils at the Missouri College of Agriculture sought a subject for a Master's thesis. After much deliberation Prof. M. F. Miller, who will be dean at the College after September 1, hit upon the idea of measuring the amount of soil eroded from plots under different crop treatments.

So the student went to the crops experiment farm at the Missouri college and laid off his plots. He had little equipment with which to work. Two by six inch boards divided his plots and the run-off was caught in wooden barrels.

Little did that lone student realize that he was starting work on a problem that soon was to attract the attention of agronomists thruout the United States, and later to occupy the full force of the U. S. Department of Agriculture and every farmer in the nation.

In two years the student turned in his paper. Prof. Miller and his colleagues sat up and took notice. The results were more significant than they had anticipated, and the problem unexpectedly loomed far above its former rating in the minds of the soils specialists.

The following year, in May 1917, the department set up an

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experiment that was scientifically correct for measuring the amounts of run-off water and eroded soil under different systems of cropping and cultural treatment.

Actual field cultivated areas were enclosed by sheet metal fencing sunk several inches into the ground, and the run-off of soil and water was caught and measured on the down-hill side. One plot each was devoted to continuous corn, continuous bluegrass sod, continuous wheat, and a rotation of corn, wheat and clover. Three plots were left bare. Thus accurate comparisons of losses from different kinds of crops and sods were obtained.

The importance of the results from these studies at the Missouri College of Agriculture was so outstanding that federal erosion experiment stations and stations in several other states have modeled their erosion measuring equipment after that used in Missouri.

Today the birthplace of soil conservation in the United States is 21 years old. From this oldest soil conservation test plot in the country comes some valuable information on saving our soil for future generations.

It has been found that on lands of moderate slope a good crop rotation almost eliminates erosion, the corn crop eroding only one-seventh as much as when grown continuously.

The average annual erosion of soil an acre is 41 tons from continually bare land, 19.7 tons from continuous wheat, 2.7 tons from a good rotation, and only .3 tons from continuous bluegrass.

This means that under actual conditions the bare soil would lose all the plow land, or the top 7 inches, within 24 years, and land in continuous corn would lose all the plow land in 100 years. Under a good cropping system, however, it would require 360 years to remove the surface 7 inches of soil, while on land in continuous bluegrass 3,000 years would be required to remove this good soil.

Naturally the amount of erosion which takes place is influenced by the slope. The greater the slope the greater the erosion, so with an increase in slope there should be more sod crops and less cultivated crops grown.

The results of these erosion measurements give a cue to practices which help to control the disastrous process that is rapidly removing the best top soil.

It is easily seen that a rotation must be practiced, one that does not allow the land to become bare at any time during the year. If the rotation does not cover the land the year-around, then the use of winter cover crops such as barley, rye or wheat, lespedeza,

vetch and various clovers, is recommended in order to lessen erosion losses during the fall, winter and spring.

Other crops such as soybeans which are sown in rows and which leave much of the area between the rows bare, may cause so much erosion as to result in serious soil loss. In such cases the crop should be sown with a grain drill and if it is possible, should be on the contour.

Fattening Beef Cattle with Grain on Pasture

Condensed from Southern Agriculturist

Chas. I. Bray

Louisiana Agricultural Experiment Station

THE production of beef cattle in the South is based upon cheap grass rather than upon corn or other concentrates, as in the Corn Belt. Consequently, any method of finishing that will make the best use of grass, with a minimum of grain feeding, is likely to be most economical. The finishing of cattle with cheap grain on pasture in summer appears to be a satisfactory method of fattening. One advantage is that the cattle gather most of their own feed, saving all labor of cutting, curing, and hauling and also other forages, and make a maximum use of grass with a minimum of other feeds. Only a small amount of time and labor is required in summer feeding, as grain only is fed. Another advantage is that the full fertilizer value of the feed is returned directly to the soil, saving a great deal of labor in hauling manure.

Grain feeding on pasture produces better gains than pasture alone, and usually results in considerable increase in selling price. Young cattle may be fattened with grain on grass when they would not finish on grass alone until two or three years old or older. Feeding grain on pasture also enables the cattleman to sell earlier in the summer, before the fall drop in prices.

Experiments in summer fattening on grass have been conducted in a considerable number of Southern and Western states. An average of some 30 comparable

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lots show an average gain of 2.25 pounds per day for cattle fed grain on grass, as compared to 1.80 pounds on grass alone. A comparison of the profits made shows that while grain feeding is usually profitable, it is not always so. An analysis of the results may indicate when grain feeding is likely to be profitable.

Factors Influencing Profits

(1) Increased sale price of fed cattle has been the greatest factor affecting profits. When the difference in selling price has been less than 50 cents per 100 pounds, grain feeding has usually been unprofitable. With a difference of 50 cents to $1.00 per 100 pounds, there has usually been a fair profit; and with a difference of over $1.00 per 100 pounds, profits have usually been good. Naturally one cannot know with certainty what prices he will get, but he may know from experience what his market is likely to pay for fed cattle in comparison with grass cattle.

(2) Increased gains and finish: Fed cattle must put on enough finish to give them a distinctly higher market classification, out of competition with grass cattle. This will usually mean an extra gain of 50 to 60 pounds over a four-month feeding period.

(3) Feed Prices: Some reports mention high feed prices as the cause of lack of profit. Feed prices, however, are usually closely related to the price of livestock, and good profits have been reported in years of high feed prices, provided that the price of cattle was also high. Homegrown feed should be made the basis of any ration.

Good pasture is the first essential in producing profitable gains, whether cattle are to be finished with grain or on grass alone. Probably our greatest opportunity for profit lies first of all in making better pastures, capable of producing 250 to 300 pounds of beef per acre per season. Finishing with grain on grass is not advisable where cattle are of inferior quality.

Rations for Fattening

The main idea is to use the feeds most readily available at economical prices. In the Cotton Belt, cottonseed meal or cottonseed cake is often used alone. The Louisiana rations have been based principally on either shelled corn or gound whole ear corn (corn-cob-and-shuck meal), with a liberal supplement of cottonseed meal. Brewer's rice was used satisfactorily in 1928-1929, but since repeal is usually higher in price than corn. Ground whole ear corn is quite satisfactory for summer feeding on pasture. Jacob, Duncan, and Neel, of the Tennessee Experiment Station, found that ground whole ear corn

was balanced more profitably with cottonseed meal than with alfalfa hay.

The amount of concentrates fed in the Louisiana tests averaged slightly over 5 pounds per day (shelled corn basis) for cattle weighing 700 to 900 pounds. This usually meant starting on 3 pounds per day in March and gradually increasing to 8 pounds during the last month or 6 weeks of feeding. Richardson, in Tennessee, suggests three-fourths pound of grain daily per 100 pounds weight of animal. For the New Orleans market, which requires light-finished cattle, a four-month feeding period is usually sufficient. For markets that prefer heavier cattle a longer period may be desirable.

Profits in four comparable tests at the Louisiana Station averaged $3.49 per steer fed grain on grass, and $0.43 per steer fed grass alone, with pastures at 50 to 75 cents per month. These estimates were based on a high spring valuation of cattle and on high market prices for feed. Using farm values for cattle and feeds, the profits would have appeared considerably greater.

All That's Sowed Is Not Seed

Condensed from American Agriculturist

M. T. Munn
Seed Analyst
New York State Experiment Station, Geneva, N. Y.

EACH season certain kinds of seeds purchased upon the open markets of New York State are planted in the Experiment Station's control fields and grown to maturity to check varietal purity and identity. When these sealed samples arrive at the seed testing laboratory, they are critically examined for purity and viability and more particularly as to their trueness to variety name. In order to prove or to check varietal purity, it is often necessary to plant the seed in the field and to grow the plants to maturity in order to be able to see all of the actual plant characters which will reveal the true variety of the stock in question.

During the season just closed 847 samples of seeds were planted in the control fields.

There were 131 samples of oats representing actual stocks of oats purchased by farmers from seedsmen, seed or feed stores, elevators, and other sources. Upon

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these 131 stocks were tags bearing at least 53 distinct and different variety names or designations. Some of these stocks were excellent.

Unfortunately, however, a large proportion of the samples, representing a huge volume sold for seed under various variety names, proved to be a hopeless mixture of varieties, or, more properly, were just "oats," with no particular varietal characters. These stocks bore names such as "Swedish Select," "Swedish Type," "Swedish Select Type," "Improved," "Fancy Selected," "Fancy Recleaned," "Heavyweight," "Northwest," "Fancy Oats Suitable for Seed," and "Seed Oats."

Some of these attempts at variety names were entirely meaningless, while others proved to be pure out-and-out frauds or deceptions. They were plainly mixtures of oats of several varieties such as would be found in feed or elevator oats.

Although no attempt was made to obtain comparative yields of grain on these rod rows, it was very plain to be seen that the stocks which were true to name and represented some care in breeding and growing were vastly superior to many of the other nondescript stocks. The greatest amount of deception or uncertainty occurred among those lots of oats sold under the name of "Swedish Select," "Swedish Type," or some form of that name which was used to lead the buyer to believe he was getting an oat of the Swedish Select variety or of some of its closely related varieties, such as Star and Victory.

Investigation has plainly indicated that the practice of selling oats of unknown variety or elevator-run oats and other cereals under definite or implied standard variety names in one of the greatest offenses against good agriculture.

From the barley samples representing large stocks actually sold for seed, 56 were selected for control field planting. Thirty-three of these were labeled "Alpha" and were sold in considerable volume to farmers under that well-known name. When these 33 barley stocks were grown to maturity, however, it was found that only half of them were the genuine, high-yielding, two-rowed, rough-awned variety Alpha which has a distinct value in this State. The other half were mixtures of two-row and six-row sorts of which the two-row sort, in some instances at least, was possibly the variety Alpha in part, or they were out-and-out misrepresentations because the barley proved to be entirely a six-row sort.

The remaining samples were sold under the name of "2-Row Barley" or "6-Row Barley" and

often with no definite variety name given. Some of these proved to be mixed varieties and mixed stocks of two-row and six-row sorts.

From the stocks of seed corn sampled 200 lots were planted in the field. The matured crop showed plainly that, as in the case of barley and oats, excellent stocks of seed corn were offered which were true to name and fully adapted to use in certain sections of this State; while, on the other hand, there were stocks which, although sold under standard variety names, could not be recognized as those varieties.

For instance, under the names of both "Pride of the North" and "Leaming," there were found stocks which were vastly different in kernel characters and which in the field varied from a uniform height of 5 to 6 feet to plants which were uniformly 8 to 10 feet high and which varied fully 3 weeks apart in date of maturity.

The situation is plainly one that can be remedied. First of all, the major responsibility rests with the seedsman or dealer. He can find out, if he will, the exact variety of the seed stocks he offers for sale. If he cannot learn with certainty the exact identity of the stock, he should not offer it as "seed"; or if he does, he should offer it as "Variety Unknown." Then the buyer acts with full knowledge of the facts and he alone is responsible if he gets seed which is of poor yielding ability.

Beans

EYES down is really the way to plant lima beans. Kentucky's bean planting experts at the state agricultural college went to the trouble of planting two 200-foot rows, one with eyes down, the other just as the beans fell. Seed in both rows was from the same package, both rows were covered one inch deep.

Results? There were 375 plants in the eyes-down row, only 200 in the hit or miss row.—*Schuyler*

Feeding Experiment with Station Jerseys

Condensed from The Jersey Bulletin

S. R. Winters

WELL bred Jersey cows will produce from 275 to 300 lbs. butterfat per year with no grain feedings if approximately two tons of good legume hay are available with good pasture.

During recent experiments conducted at its field station in Lewisburg, Tennessee, by the Bureau of Dairy Industry, United States Department of Agriculture, 16 Jersey cows were under observation for one year to determine the exact results of milk and butterfat production when fed exclusively on legume hay and pasture. These 16 Jerseys made 17 lactation period records on these rations. Their production for an average lactation period of 361 days, was 6,333 pounds of milk and 329 pounds of butterfat, while the average loss in body weight was 33 pounds to the end of the period, not taking into consideration the gains which would be made normally during the dry period prior to calving.

When fed legume hay, pasture, and liberal amounts of grain, these same Jerseys produced 9,659 pounds of milk and 527 pounds of butterfat with an average gain of 70 pounds in body weight to the end of the lactation period.

On roughage alone, the cows produced 67 per cent as much milk and 62 per cent as much butterfat as when fed under the Register of Merit conditions. During the period when hay was received without pasture, an average of 28.6 pounds of hay per cow a day was consumed, or 3.44 pounds per 100 pounds of body weight.

Though the Lewisburg experiments show roughage-alone rations produce less milk and butterfat, they offer conclusive proof that the percentage of profit to the dairy farmer is greater and can be used to advantage when prices received for dairy products are low.

Nutriments in the form of roughage are produced cheaper than in the form of grains. The operating costs of feeding 100 pounds of totally digestible nutriments in oats, wheat, corn and barley, as compared to hays, are 155 per cent more in oats, 189 per

Reprinted by permission from the Jersey Bulletin, Indianapolis, Indiana

cent more in wheat, 34 per cent more in husked corn and 111 per cent more in barley. Thus, the lower cost of producing roughage more than offsets the lower production per cow which is secured when roughage-alone is fed. Gross returns over cost of producing feeds when butterfat is bringing 20 cents per pound is 96.9 per cent greater when a hundred-acre farm grows legumes alone, against 55.4 per cent when the same one hundred acres are in grains sufficient to supply a limited grain ration.

While feeding and farming according to the roughage system would augment the dairy farmer's income by enabling him to produce milk and butterfat at a lower cost, it is equally true that when legumes are grown, there is no necessity for rotation, except where disease or insects destroy the roughage crops. Experiments have proven that a succession of roughage crops is more effective in reducing erosion and the resulting loss in soil fertility than rotation in ordinary cultivated crops.

To obtain the best results in feeding without grains, there are several important factors which should be borne in mind. Legumes of excellent quality must be used, and should be cured so as to retain a good, green color. Care must be taken to prevent unnecessary crumbling of leaves. This makes for a high protein content and increases palatability. Roughages are more nutritious when cut in their early stages of maturity than when cut later. Better roughage may be secured by improved methods of artificial drying, by improved methods of field curing, and by proper treatment of the soil. Soils that are deficient in mineral matter should have applications of proper minerals so there will be no deficiency of any sort.

Cows that have been accustomed to extremely heavy grain rations must be trained to consume large amounts of roughage. This is best accomplished by putting them on larger roughage rations sixty days or more before freshening.

Types of Pumps for Farm Use

Condensed from Electricity on the Farm

Wallace George

THERE are three main types of pumps which are commonly used on farms: reciprocating, centrifugal and rotary.

RECIPROCATING PUMPS: *Shallow Well* variety. These are the best known and include pitcher pumps, hand pumps, such as those used on the old thresher water wagon, and pumps used on shallow well water systems. They are also used for sprinkler irrigation systems where a high pressure is needed and the pump can be placed near the water.

The outstanding characteristic of this pump is that it raises water by suction. Suction draws the water up into the pump cylinder where it is given a push and lifted into the elevated tank or squeezed into the pressure tank.

Suction is important in pumping water. Surrounding the earth is a layer of air about 8 miles deep. A column of air one inch square and 8 miles high weighs 14.7 pounds. In other words, every square inch of the earth's surface is holding up 14.7 pounds of air; or we say, the atmospheric pressure is 14.7 pounds per square inch. Now if the air pushes with a pressure of 14.7 pounds on every inch, you say something ought to move. Well, it would except for the fact that that something is being pushed on from all directions with the same force; therefore it stays still. If you put a long pipe down a dug well into the water and suck the air out of the top, the water will be pushed up into the pipe by the weight of the air on the water in the well. If you suck hard enough to remove all the air (create a perfect vacuum) that 14.7 pounds per square inch would push the water up in the pipe to a height of over 33 feet. But no one is that much of a sucker, not even good water system pumps now on the market. About the best job of sucking they can do, even when they're down at the beach, is to remove enough air so the water will be pushed up 22 feet. That's sea level. In Denver, a mile high, there is only a 7 mile column of air pushing down on the earth; and that upper air is lighter than the layer on the bottom. So at Denver, with the same job of sucking, water would be pushed up in the pipe only about 17 feet.

The practical suction lift of a pump at sea level is about 22

Reprinted by permission from Electricity on the Farm, New York, April, 1938

feet, and it drops off one foot for every 1,000 feet you go above sea level. It is best not to depend too much on the suction of a pump. If the water does not run into the well as fast as you pump it out, or if the pistons or valves or leathers wear, or you get a little dirt or scale under a valve, then it doesn't suck so well.

"What do you do when the water is more than 22 feet below the surface?" You put the pump down closer to the water. You may place a shallow well pump in a pit or in your cellar; or you may put the pump cylinder down in the well and work the "sucker" with a rod that comes to the surface. That's what is known as a *deep well pump.*

Air Suction Determines Type of Pump

After the water is once in the pump cylinder it can be raised any distance or against high pressures just by lifting it with the piston. It's that air sucking business that determines whether you will need a deep well or shallow well pump.

Deep well pumps have the pump cylinder down in the well and usually a rod runs down to operate the piston. The well cylinders may be 2½ inches in diameter or larger. Pump rods are of wood or steel, wood being a little lighter and stiffer. The pump head and motor (or pump handle), the mechanism that makes the rod go up and down, must be located directly over the well.

A pump jack is a set of gears and cranks operated by an electric motor and which may be attached to a hand or windmill pump to operate the pump rod. Pump jacks are an intermediate step between the windmill and the modern water system. They should be well designed and properly installed if good service is expected.

There is also another type of deep well reciprocating pump which uses no rods. The mechanism is down in the well and is operated by compressed air forced down to the pump through a small pipe. The motor on the surface drives the compressor which supplies the air.

By far, the greater percentage of farm water systems use pumps of the reciprocating type.

Centrifugal Pumps operate somewhat on the principle of an ensilage blower. Instead of feeding chopped silage to the center of a rapidly rotating fan and having it thrown up the pipe by the blades or vanes, water is fed into the pump and forced through the pipe in much the same manner.

The centrifugal pump must be filled with water (primed) before it will begin to pump. When filled with water and connected to the well or pond by a suction pipe, which is also full of water, it will

pump. As the water is thrown violently out of the pump a suction is created and more water flows in to be "slapped" into the discharge pipe.

Centrifugal pumps are commonly used for pumping water for irrigation. Small pumps deliver large quantities of water. They are simple and there is little to get "out of fix." They will pump dirty, sandy water without costly wear. They are relatively inexpensive.

The centrifugal pump is not a universal pump, however. It will stop delivering water if called upon to pump against pressure greater than it was designed for. It must be primed or have an automatic priming system to keep it full of water. It is not positive in action nor uniform in discharge.

A helpful rule for getting the approximate gallons per minute a single stage centrifugal pump will deliver is to take one-half the diameter of the discharge pipe in inches, square it and multiply by 100. Example: How many gallons of water per minute will a 3-inch centrifugal pump deliver?

$$\text{Answer: } \frac{3}{2} \times \frac{3}{2} \times 100 = 225.$$

There are several different kinds of centrifugal pumps. The open runner pump is cheapest, will handle the dirtiest water, but is the least efficient. The closed runner pump is more efficient. The difference is in the design of the blades that throw the water.

Turbine pumps are centrifugals with guide vanes or passages to direct the flow of water through the pump and to increase the amount of water pumped per unit of power.

In the East, where irrigation pumps may be run only a few weeks in the year and where first cost is more important than operating expense, ordinary centrifugals may be best. For high lifts and frequent use the more expensive turbines will probably be more economical to use.

The ordinary single stage centrifugal pump has a maximum lift of about 70 feet (above the pump). Modern high speed centrifugals and turbines may lift much higher. Centrifugal or turbine pumps may be horizontal (shaft horizontal) or vertical (shaft vertical). They may be large in diameter or as small as 5 inches so they will go down a well casing.

Where it is desired to raise water more than 70 feet, two or more pumps are coupled together, one discharging into the suction of the next. When built as one unit, this is called a multistage pump. Some of the Western irrigation pumps used in 10 to 16 inch wells have as many as 6 stages.

Some specially designed centrifugal pumps are used in shallow well water systems and have given highly satisfactory performance. Deep well turbines are also used on water systems, but are usually intended for larger quantities of water than average farm water systems. A new deep well turbine pump recently placed on the market has the motor direct connected to the turbine and submerged in the well.

Rotary Pumps do their own sucking and need not be primed. There are many styles on the market. They are excellent for pumping heavy syrups, oils and other liquids containing no grit. Sand cuts most of them out quickly. Cheap rotary pumps are a joy when new, but a pain when they are worn. In the proper place, the rotary pumps are fine pumps, but they have less place on the farm than other types.

Phosphatic Fertilizers

Condensed from the Fertilizer Review

PHOSPHORUS is one of the most essential of the 92 chemical elements. It is indispensable to the life, growth, and health of both plants and animals. It is an important component of the bones of both human beings and animals. It is present in the protoplasm of every cell in animal and vegetable bodies. In addition it occurs widely in many rocks and in all soils throughout the world.

Phosphorus was discovered, isolated, and named in 1669 by Brand, a Hamburg merchant and alchemist, while searching for the philosopher's stone in human urine. He made up the name from two Greek words that mean light-bearing.

Phosphoric Acid

Phosphoric acid was not discovered until 1743 when Margraff ascertained its composition and succeeded in reconverting it into phosphorus. In 1769 Gahn found this acid in bones. Not long thereafter (1779) he determined its presence for the first time in a mineral, pyromorphite, not one of the calcium minerals now its universal commercial source, but a lead phosphate.

In 1775 Scheele described a method of producing phosphorus that is still in use in its main features. He apparently was not particularly interested in phosphoric acid, the most important phosphorus compound.

Gradually scientists, recogniz-

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ing the presence of phosphoric acid in animals and plants, realized that its source must be in the foods they consumed. It was not until around 1800 that agronomists and other scientists recognized and freely admitted that the soils in which plants grow are the source of the phosphoric acid they contain. Before that time they clung persistently to the belief that it was derived from other substances.

In the order of their commercial importance, the following materials are the chief sources of available phosphoric acid for use in fertilizers: (1) Superphosphate; (2) basic slag; (3) ammonium phosphates; (4) concentrated superphosphate; (5) bone meal and other available natural phosphates; (6) calcined phosphates.

1. *Superphosphate*

Superphosphate is the product of treatment of phosphate rock with sulphuric acid, roughly ton for ton.

In 1835 Escher first suggested the acid digestion of bone meal to make its phosphorus content available. In 1840 von Liebig, in his "Organic Chemistry in Its Application to Agriculture and Physiology," prepared at the request of the British Association for the Advancement of Science, suggested increasing the availability of the P_2O_5 contained in bone meal by treatment with sulphuric acid.

In 1842 John B. Lawes, of Rothamsted, took out a British patent for treating bone ash with sulphuric acid. In his application for patent (No. 9353) he said:

"I mix (with) the bones, bone ash, or bone dust, or with apatite or phosphorite or any other substance containing phosphoric acid, a quantity of sulphuric acid just sufficient to set free as much phosphoric acid as will hold in solution the undecomposed phosphate of lime."

In 1845, with his life-long associate J. H. Gilbert, a student of von Liebig's, Lawes started the superphosphate industry which continues to grow even today. Lawes' manufacture was based upon his own patents combined with those of Sir James Murray, a Dublin doctor. In 1845 low-grade mineral phosphates called coprolites were discovered in England and France. In 1856 and 1857, on the recommendation of Beaumont of France, and Liebig of Germany, these mineral phosphates were turned to agricultural use. Within five years (1862) the production of superphosphate in England had reached 200,000 tons.

In 1867 the superior South Carolina rock phosphate deposits were discovered, resulting in the development in the United States of what always since then has

been the largest superphosphate industry in the world.

Similar developments, based largely on exports of American rock, occurred in Germany and France as well as in England. The growth of the industry is best shown by the fact that in 1937 more than 15,000,000 tons of superphosphate were produced in the world.

More than 90 per cent of all the available phosphoric acid used in American fertilizers is derived from superphosphate of the 16 to 20 per cent grade. The total tonnage of superphosphate used in making mixed fertilizers and for direct application to the soil amounts to more than 50 per cent of the total tonnage of all fertilizers and fertilizer materials consumed annually in the United States.

The product obtained from treating normal superphosphate with anhydrous ammonia liquor is usually called ammoniated phosphate. This usually carries not to exceed 3 per cent of nitrogen and 18 per cent of available phosphoric acid.

2. *Basic Slag*

Basic slag, used for fertilizer, is a by-product of the improved Thomas and Gilchrist process for refining pig iron. German investigators in 1883 first called attention to its fertilizer value. By 1887 some 300,000 tons of ground slag were used in Germany alone. In 1935 Germany used approximately 1,800,000 tons, and France over 900,000 tons; total European consumption amounting to 4,600,000 tons.

European iron ores have a far higher phosphoric acid content than American ore. Our steel industry produces a small amount, and some was formerly imported. Today only meager quantities are used in the United States.

Basic slag is a good source of available phosphoric acid, but it is not suitable for use in mixed fertilizers.

3. *Ammonium Phosphates*

Commercial ammonium phosphate is prepared by mixing liquid or gaseous ammonia with phosphoric acid. It usually contains from 10 to 12 per cent of nitrogen and 45 to 50 per cent of available phosphoric acid.

The ammonium phosphates are very satisfactory sources of both nitrogen and available phosphoric acid. Concentrated ammonium phosphates, when used as the sole source of phosphoric acid on many light soils, have failed to give satisfactory results, chiefly because they contain insufficient calcium and sulphur.

4. *Concentrated Superphosphate*

We believe that the term "concentrated superphosphate" is the preferable generic name for the material formerly called "double superphosphate" and more recently known as "triple super-

phosphate." Superphosphate is the product that results from the first treatment of raw phosphate rock with sulphuric acid. Depending upon the calcium phosphate content of the raw material, this produces normal superphosphate containing from 16 to 20 per cent of available phosphoric acid. The term "double superphosphate" arose from the fact that when phosphoric acid was prepared by the sulphuric acid process, and then used on a second portion of phosphate rock, a concentrated superphosphate containing from 40 to 48 per cent available phosphoric acid was obtained. When the furnace processes are used there is only one acidulation and the term "double" is no longer applicable. The practice of calling "double superphosphate" "triple superphosphate" came about because the material contained approximately three times the phosphoric acid content of 16 per cent superphosphate. When double acidulation is practiced, the correct terminology would certainly be "double superphosphate," particularly because at present nearly all superphosphate contains more than 16 per cent of available phosphoric acid. Clearly neither term is now accurate as a generic term suitable for all conditions.

5. *Bone Meal*

Bones are the oldest source of phosphoric acid, and bone meal is a good fertilizer material. Only a relatively small quantity of bone meal is now available for use as fertilizer. It is a slower acting material than superphosphate, but it is valuable for use on such crops as winter wheat and pastures.

6. *Calcined Phosphates*

Many processes have been proposed for rendering the phosphoric acid content of phosphate rock available by heating the ore without volatilizing the phosphorus. The product has been used to some extent in some European countries for a number of years. Much experimental work has been carried on in this country, but no commercial production. This material will not absorb free ammonia and has this distinct disadvantage as compared to superphosphate.

Minerals and Good Horses

Condensed from Hoards Dairyman

AT the recent annual meeting of the Horse and Mule Association of America, Dr. Robert Lee Humphrey gave an interesting account of how he assisted in making the E. B. McLean race horses head the list of money winners in 1928. From his address we take the following extracts:

On July 1, 1926, at the invitation of the owner of Belmont Plantations, Leesburg, Virginia, I took charge, for a two-year period, of his farm which was devoted entirely to breeding race horses. These horses were raced by their owner and breeder who raced no others. Although he had spent considerable sums of money to secure good breeding stock and although no expense was spared in training these horses, the results had been disappointing.

The owner was inclined to put a large share of the blame on his two stallions which had been extensively used. The trainer added that all the colts by one of these would break down in training before they could be gotten ready in a thorough way for racing. They suffered, he said, from bad legs and soft joints.

After hearing a good deal about how bad the horses were, I went to the farm for a thorough inspection. At first glance it was apparent that this farm was lacking in sufficient grass to carry the number of horses quartered there. However, on the whole, the physical condition of the colts looked satisfactory. Their coats were bright and they were fat.

Looking for a clue as to where to start, I took blood samples from various colts which were the produce of a cross section of the mares — that is, from maiden mares, from mares having had a few foals and from old mares having had many foals. These blood samples were sent to a well known laboratory for analysis. The report came back that all these animals, without exception, were badly deficient in calcium and phosphorus. Here was a clue worth following, pointing to a condition which could be remedied.

Fortunately there was a considerable accumulation of manure in the cattle yard. This was spread at once, and followed by an application of one ton of ground burnt lime to the acre. After the first rain, the land so

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treated was reseeded with mixed clovers and a small amount of bluegrass. Following this, on the same land, 350 lbs. of 16 per cent superphosphate to the acre was spread. These applications were made at the far end of the colt and filly pastures, partly because that end of the pastures had been badly neglected, and partly because the best grass there would mean additional exercise for the stock going to and from the barns. However, so attached did the colts and fillies become to these far ends of their paddocks that it was often necessary to send a man down to bring them back, even at feed time. Their preference for these fertilized and mineralized plots, which they had previously scorned, was unmistakable.

The feeding schedule was changed. The cook room was closed, and during my time at the farm was used only as a store room. No feed was cooked. Still following the clue of mineral deficiency, the heaviest oats obtainable were brought from the Pacific Coast at a cost of $1.00 per bushel, delivered at the farm. The mineral content of these oats is so heavy in comparison with standard oats that for purposes of supplying mineral deficiency they appeared cheap even at that price. With these oats was fed green alfalfa meal not exceeding one pint per feed together with bran, yellow corn, and linseed meal. The colts were also fed a cod liver oil emulsion containing calcium and phosphorus. This emulsion was fed for ten days, then suspended for ten days, then fed for another ten days. During the ten-day suspension, mineral oil was substituted. This was all the grain ration, based on the old theory that hard grain makes hard horses.

At the end of ninety days from the time this feeding schedule and mineralizing program had been put into effect, blood samples were again taken from the same animals as before. This time, instead of reporting by telephone, the chemist from Johns Hopkins laboratories called personally to find out what had made such a radical increase in the quantity of minerals showing in his analysis of the blood samples.

At this point I should explain that I followed the course I have just outlined because I believed it is better to supply these minerals through the natural feeds as much as possible, rather than through artificial concentrates.

The horses which had been racing for the stable in 1926 came back to the farm late in the fall of 1926 for the winter of 1926-27. They, too, were put on a feeding schedule assuring an ample supply of essential minerals. Naturally it was with some anxiety and

a lively degree of curiosity that I waited to see what the 1927 racing season would hold for our horses.

The results were emphatic and surpassed my rosiest hopes. In 1926 the stable had won about $46,000; that is, about $10,000 more than its ten year average. In 1927 it won over $186,000. In 1926 it won 28 races—in 1927 it won 58. The number of races was doubled, but the amount of money won, quadrupled.

In 1928 it was even better. The stable won 60 races worth $234,640, putting the owner in the enviable position of leading the list of money winners.

In this story there is one point of cardinal interest. The owner in question raced only the animals he had bred himself, with only one exception that I can recall. The large winnings, therefore, were entirely made, to all intents and purposes, by animals bred at Belmont. When given an adequate supply of minerals contained in a proper feeding schedule, these animals proved themselves about the best race horses in the country. Without proper nutrition, they were indifferent performers even when they stayed sound enough to race.

N. J. Artificial Breeding Society

Condensed from Holstein-Friesian World

Allen N. Crissey

ARTIFICIAL insemination is here on an organized basis. The New Jersey Holstein-Friesian Association has been reorganized and incorporated and has launched the first society of this kind in America with 993 applications signed up by 90 farmers.

It is a far cry from the experiments of Spallanzani practicing artificial insemination on a dog in 1770 to the recent Russian accomplishment of 70,000 horses in one year. In Denmark the "Elite Breeding Society of Sams" came into being in 1936 as a co-operative organization of Danish dairy farmers for artificially impregnating cattle. Last Summer they completed the first year's activities and found they had impregnated 1,200 cows with a 40% better record of conceptions than by natural means.

Professor Enos J. Perry, State

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Dairy Specialist and active secretary of the Holstein-Friesian Association of New Jersey, was touring the dairy sections of Europe at the time and spent several weeks with Dr. K. A. Larsen, the veterinarian in charge, carefully studying his technique and sounding out the sentiment of the members of the society. The 1,200 cows were owned by 220 different farmers since most farmers only entered a few of their best animals.

Professor Perry returned to America thrilled with the possibilities of artificial breeding and determined to give it a trial here. Speakers and writers have visualized its possibilities as to ushering in a new era of dairy cattle breeding. Individual breeders and experiment stations everywhere have been trying it out in their own herds, and when Professor Perry proposed a co-operative movement along these lines, he found a receptive attitude in all quarters.

The Organization

The subject of artificial breeding was given a prominent place on the program for the annual meeting of the association held on January 14th in New Brunswick. Professor Stanley Brownell, of Cornell University, was invited to put on a demonstration using a cow and bull at the New Jersey college farm. At that meeting they authorized the officers to reorganize and incorporate the state association into an artificial breeding society.

Regulations for Artificial Breeding

The artificial breeding work is to be managed by a committee of five members of the association, all of whom must be co-operators in the artificial breeding project. The regulations provide that a qualified veterinarian shall be employed by the Board of Directors of the New Jersey Holstein-Friesian Association upon recommendation of the local committee.

Qualifications for Co-operators

The privileges and services of the Project shall be open to anyone who pays a Participating Fee of $5.00 to the treasurer and who in addition subscribes to the rules finally drawn up by the managing committee and who pays the fixed annual service fee for cows. The participating fee of $5.00 is required to purchase equipment and to provide funds toward the stabling, feeding and handling of the bulls and in addition it provides membership in the New Jersey Holstein-Friesian Co-operative Association.

A co-operator shall list with the secretary the approximate number of cows to be artificially bred during the year and a new list shall be required at the beginning of each year that the Project is in operation.

Yearly Service Charge Per Cow

The yearly cost per cow will depend upon the total number of cows listed for breeding. It should run between $4.00 and $6.00 per year and will cover (1) breeding of cow and (2) examination for pregnancy. Reasonable effort will be made to get a cow in calf by the veterinarian, but he shall not be required to breed any cow more than three times between calvings. The service charge shall be paid to the veterinarian at the time each cow is bred. He shall furnish a receipt and turn the money over to the treasurer.

Extra Charges for Treatments

If in connection with visits to perform his primary duties of breeding and examining cows for pregnancy, the employed veterinarian has time available for the treating of any listed cows afflicted with breeding trouble, he may perform such service, charge a reasonable price for it, collect the additional fee, give a receipt for it and turn it over to the treasurer. Above a reasonable surplus, the balance of money in the hands of the treasurer at the end of the year shall be returned to the co-operators in proportion to the fees paid in.

Identification of Animals and Keeping of Breeding Data

For the purpose of proper identification a coupon book shall be used by the veterinarian at all times. When a cow is bred, full information such as sire used, date, name and number of cow, owner, etc., shall be marked down on the coupon or receipt given to the owner. Exact duplicate information shall be set down on the stub by the veterinarian for filing and reference. In addition the owner is required to keep breeding records on special furnished forms. A file card shall be kept for each treated cow. This will include information about preconception treatment, if any, the dates of insemination and examination for pregnancy. The managing committee shall have the right to limit or increase the number of cows, as the necessity for the successful operation of the project requires. If within the herds of several of the co-operators are cows of other breeds which the owners are desirous of breeding artificially to a meritorious sire, the managing committee shall endeavor to secure the use of a qualified sire for this purpose. Enough cows would have to be available to warrant this extra step and the owners of the other breed must be willing to pay the additional charges that would probably be involved.

Sires to be Used

The association has leased one outstanding sire and arrangements will be made for another. The first sire is N. J. E. S. Sir Mutual Ormsby Jewel Alice who

has been leased from his joint owners, the New Jersey Experiment Station and Peter P. Van Nuys, Belle Mead, N. J. He is one of the outstanding proved bulls of the United States. His first 13 daughters averaged 15,470 pounds of 3.85% milk and 596 pounds of fat, while their 13 dams averaged 14,090 pounds of 3.5% milk and 493 pounds of fat. This gives "Alice" a "B" index of 16,850 pounds of 4.20% milk and 708 pounds of butterfat. The income from the sale of additional milk produced by the daughters of this bull as compared with their dams has amounted to $36.00 per year. If you like to count your chickens before they are hatched you can figure that this bull will contribute a sizable sum to New Jersey dairymen through artificial breeding to a large number of cows. He is now only six years of age.

Advantages of Artificial Breeding

Some of the advantages which are expected from artificial breeding are as follows:

1. It should result in a more accurate breeding record of the co-operating herds than is usually kept by individual breeders.

2. Superior sires will be made available at less cost per service than otherwise. The department of farm economics in New Jersey found bull service cost on New Jersey farms to be $7.03 per cow.

3. Dairymen who have been milk producers only may now become breeders of cattle as well.

4. Dairymen who have been raising no calves may now raise their own replacements, a better dairy practice.

5. Owners of small herds need not have the additional expense and bother of keeping a bull.

6. The space that has been occupied by the bull may be used as a calf pen, maternity pen, or for additional milk cows.

7. The danger of diseases which are spread from cow to cow by the bull will be practically eliminated.

8. The plan lends itself to linebreeding on a large scale, a large family of one kind of breeding in a community.

9. The genetic ability of sires can be measured more effectively.

10. The physical condition of the herds should improve as a result of the regular services of the association's employed veterinarian. Problems of sterility should be lessened.

11. The problem of breeding yearling heifers to a large heavy sire will be eliminated.

12. Participation in a better breeding program, the study of breeding problems and posssibilities by a large number of farmers in the same community should bring forth the best thought and community spirit for advancement of the breeding business.

When There's a Snake in Sudan Grass

Condensed from Capper's Farmer

C. K. Connors

EIGHT cows were borrowed from a local packing plant by experimenters at the University of Wisconsin and turned on a patch of Sudan grass. They grazed briefly and quit. Twice after that they began to feed but gave it up as a bad job after a total of not to exceed 15 minutes.

Next day those same cows were turned on another area of Sudan and they grazed 85 minutes without interruption. It was a complete fill.

Why the discrimination? The first grass was loaded with a deadly poison, hydrocyanic acid. The other was safe. And the cows in some way knew the difference.

In the University dairy barn is a cow which once experienced the discomforts of the acid poisoned Sudan grass. Many times since she has been used as a demonstration to confirm laboratory findings. Offer this cow a cutting of dangerous Sudan forage and she may nibble but never eats it. Give her safe Sudan forage and she will consume it with relish.

Now if cows can distinguish prussic or hydrocyanic acid in Sudan grass, what is the occasion for losses? College authorities estimate approximately 100 Wisconsin cows died on the pasture last year. In many cases the animals broke out of drouth seared pastures to eat of the deadly grass. Then it must be that some cows can distinguish the poison and others can't?

Yes, but Wisconsin research workers have discovered that it is a matter of condition rather than discrimination. They believe that the dangerous grass will forewarn most cows, but if they are extremely hungry, drouth starved and emaciated they will ignore the distress in their middles and eat too much, take a fatal fill. Invariably the cows which have shown discrimination in grazing tests have been in at least fairly good condition.

That led to another practical test. Three well fed and three emaciated cows were turned to Sudan pasture, known to contain dangerous quantities of the poison. After 10 to 15 minutes of grazing, all cows quit and began to wander across the area. One of the emaciated cows went down

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in mid field. Her reaction indicated a fatal dose and a veterinarian applied treatment. The remaining cows continued across the field, nibbling now and then, but not eating freely. A second of the emaciated cows went down a few minutes later. The other four, three well fed and the one remaining emaciated cow, which which was in better condition than the others, remained on their feet.

A Kansas farmer related not long ago that Sudan grass pasture had been used by him and his father for years in Franklin County. Never had they had any trouble, dry years and good. That experience has been related often by farmers in Kansas and elsewhere south of the middle Corn Belt. How come, then, that Wisconsin farmers fear Sudan? For the present that difference in experience must remain unexplained.

Dairymen report that nothing stimulates milk flow during hot fly-time weather as Sudan does. Yet acreage has been declining in Wisconsin because no pasture at all is better than dead cows.

"We determined to learn if Sudan might be safely used," said Emil Truog, of the experiment station soils staff. "A rapid and accurate test for determining the hydrocyanic acid content of Sudan was developed. We learned that it was highest when the and in absence of a cyanide con- grass was 4 to 6 inches tall and when it was a dark green color. By repeated tests from fields previously observed, we can just about determine by inspection whether the grass is in a safe or a dangerous stage.

"Eventually I expect that farmers will be able to make the same observations themselves, but for the present we are advising a test. Facilities for making poison determinations are maintained at the University and any farmer in the state can send in his samples. Most of them can know within 24 hours whether the grass is safe to pasture." Making the determination requires about 15 minutes.

Various associates in the College of Agriculture co-operated with Professor Truog in the work. Their conclusions are that:

1—Short, dark green Sudan is dangerous because it contains a high percentage of cyanide. Second growth after pasturing or removal of hay is especially dangerous in the same stage. Grass that has reached a height of a foot or more is relatively safe. Also that which is a pale yellowish green is low in cyanide poison whether it is short or tall. But do not mistake dried or brown leaves, resulting from drouth, for this pale green color, because in the field may be many short, dark green plants.

2—In case of doubt as to color

tent test wait until the crop is two or preferably three feet high before turning cattle on it. This delay also will insure maximum pasturage.

3—Uneven stands should be regarded critically. Many fields will average two or three feet tall, yet areas will be short. Wisconsin experimenters recommend careful examination of such areas and in case of doubt recommend a cyanide test. Unevenness may be caused by variation in fertility or moisture supply in different parts of the field.

4—Stock poisoning from Sudan in drouth years probably results from slow growth. The plants do not receive enough moisture to advance them beyond the dangerous stage. It is possible that this same lack of moisture limits the supply of phosphorus to a greater extent than it does that of nitrogen. Also, cattle, owing to feed shortage, are more likely to be emaciated in drouth than in normal summers.

5—Cyanide content of Sudan hay is not greatly different from that of the green standing plant from which it was made. The reason trouble is so rarely experienced from the hay is that farmers, desiring a good yield crop, do not cut the crop for hay normally until it has grown past the dangerous age. Short, dark green grass made into hay is likely to be dangerous.

6—Cows vary in the amount of cyanide required for a fatal dose. But, as indicated in preceding paragraphs, a hungry or emaciated cow is quite likely to over-eat irrespective of any resistance she may possess. Hence it is advisable to watch the herd a while when it is first turned on Sudan. If some of the cows stop grazing after a few minutes or if they seem to be selecting taller growth, it may be assumed that the pasture is not safe. Remove the cattle and await further growth. Normal, low cyanide content grass is highly palatable. A fill of hay, grain or other pasturage may be helpful in preventing the cows from taking an overfill of Sudan until it can be proved safe.

Fortunately the cultural and management practices which make Sudan safe also afford maximum pasture yields. Commonly the crop is planted as an after-thought—as an emergency stop gap when the farmer senses pasture withering drouth ahead or after his seeding has winterkilled. Little opportunity for selecting land, or fields, or in providing safe pasturage is afforded if he waits that long.

The greatest service will be had from Sudan if it is given a place in the rotation or among the pasture crops. In that case:

1—Select a field or area of uniform fertility and one which will

not erode. That means, preferably, a level space since top soil will not have been washed off in places, and moisture will not run off of some portions and collect on others to result in uneven growth of the prospective crop.

2—Fall plow or otherwise work the land to open the surface to moisture penetration.

3—In spring cultivate the soil after rains to kill weeds and to make a firm seedbed.

4—Apply fertilizer if needed. A simple test can be made either by the state college or by the county agent which will show whether nitrogen and phosphorus are out of balance.

5—Sow the last of May or first of June. That is the optimum seeding time north of the middle Corn Belt. Sudan is a warm weather crop.

6—Divide the area or provide two plots so that they may be grazed alternately.

7—Do not turn the cattle on until the shortest plants are two feet high.

That is the 7 point recipe for, first, a safe pasture and second, a maximum yield.

Clean Cultivation for Bindweed

Condensed from Kansas Farmer

F. L. Timmons

In Charge, Federal-State Weed Laboratory, Hays

CLEAN cultivation is by far the most dependable and economical of all bindweed eradication methods now known. This method was originally worked out at the Hays Experiment Station in experiments conducted by R. E. Getty from 1919 to 1927.

The death of bindweed plants under the fallow treatment is first due to starvation. Bindweed, like all other perennial plants, has an extensive root system which ordinarily has a large supply of plant food reserves. The food is manufactured in the leaves. When the above-ground parts of bindweed are cut off, it must draw upon the food reserves in the roots. In this way the supply of food reserve in the roots is gradually taken out.

The best cultivating implements to eradicate bindweed are the duckfoot and the blade type of weeders. With duckfoot sweeps the overlap should be at least 3

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inches, while with blades it should be 5 or 6 inches. The sweeps or blades must be kept sharp if they are to do best work. It is essential to cut off all plants 4 to 5 inches below the surface at every operation. Disks or spring-tooth harrows will not do this ordinarily so are not satisfactory.

Spring is the best time to begin cultivation treatment of bindweed. Food reserves are lower then and soil moisture conditions are more favorable to rapid growth of the weed. When cultivation is started after wheat harvest, more time and more tillage operations have been required to complete the eradication.

Tillage after harvest the first season was almost entirely ineffective. The most probable reason for this was that every year the soil has been too dry after harvest for normal growth of bindweed after every cultivation, with little exhaustion of food reserves.

Heretofore it has been recommended that cultivations be repeated often enough to prevent any growth above the ground. This requires cultivation every 5 to 10 days, with an average of one a week. Recent experiments show that better results are obtained when the bindweed is allowed to grow several days above the ground after every cultivation. At Hays the results have been best when the bindweed was allowed to grow 8 days after every first emergence. On the average, only 15 cultivations were required to eradicate bindweed when it was allowed to grow above the ground 8 days, and 19 were necessary when it was allowed to grow 4 days. When the bindweed was cultivated the first day it emerged every time, 26 cultivations were required. However, when actual top growth was allowed for 12, 16 and 20 days between cultivations, more time was required for eradication, and in some cases there were some bindweed plants left after 2 years of treatment.

It has been found that food reserves in the bindweed roots were decreased rapidly during the first 8 to 12 days of top growth, thus leaving the plants weaker than at first emergence. When the plants were allowed to grow longer than that, they began to regain their strength from food manufactured in the tops.

It seems advisable to recommend that bindweed be allowed to grow above the ground not more than 8 days between cultivations. Under Hays conditions bindweed has consistently emerged in 6 or 7 days after every 4-inch cultivation in mid-season. This means that when an 8-day top growth is allowed, the cultivations must be repeated every 14 or 15 days. In early spring and

late fall there may be more time between cultivations. If, for any reason such as shallow cultivation or extremely favorable growth conditions, the bindweed emerges in 3 or 4 days the cultivation should be repeated in 11 or 12 days. In most cases the safest plan is to repeat the cultivations regularly every 2 weeks as long as the bindweed emerges quickly after it is cut off. It is usually better to delay cultivation 2 or 3 days when the soil is too wet for thorough work. In cases of long-continued wet weather, the land may need to be plowed while wet with a moldboard plow, but duckfoot or blade weeders usually will not operate successfully in wet soil.

In the experiments at Hays, 8 and 12-inch depths of cultivation have proved little if any more effective than 4-inch depths. The best plan has been to start with a 6-inch moldboard plowing, and follow up with duckfoot cultivations to the depth of 4 to 5 inches.

Under Hays conditions the average cost of eradicating bindweed with clean cultivation is about $15 an acre when all top growth is prevented, and about $10 an acre when 8 days of top growth is allowed between cultivations.

Since the cultivation treatment for bindweed usually can be used as the fallow seedbed preparation for wheat or sorghum in Western Kansas, the direct cost of eradicating bindweed is reduced to from $5 to $6 an acre.

Many experiment stations recommend alfalfa as a smother crop for bindweed on irrigated land. The land is clean-cultivated from early spring until the alfalfa is seeded in August. After the alfalfa is plowed up at the end of 3 to 5 years the bindweed usually is all gone, or is so thin and weakened that it can be easily killed out by the cultivation for the next crop. It is possible that the plan might be effective in Eastern Kansas. Alfalfa is about the only crop for which it pays to summer fallow in that section; hence it seems that alfalfa would be about the best crop to follow a clean cultivation treatment whether it be continued one season or two seasons.

Farm Land Is Worth What It Will Earn

Condensed from Successful Farming

POINTED indications that farm land buyers generally give too little thought to the real earning power of the farms they buy, are contained in a recent farm valuation study by G. A. Pond and W. L. Cavert, agricultural economists of the Minnesota College of Agriculture. These men studied 32 southeast Minnesota farms on which complete records had been kept for 5 years, 1928-32, and found that the earning power of these farms showed much wider variations than are usually found in actual sale prices of different farms in a given section.

Probably the reason lies in a too-hazy conception as to what factors chiefly determine the earning capacity of a farm. These factors are brought out sharply in the Minnesota study. They are soil fertility, the percentage of the land that is tillable, and its adaptability to the production of high-value crops. These high-value crops vary for different sections, but in southeast Minnesota they are principally corn and alfalfa. What a farm will earn in any given year will also depend on the operator's efficiency, but allowance for this factor can be made in any given case.

Even tho none of the 32 farms studied were distinctly inferior as to either land or management, the "capitalized" or earning values ranged from $28.43 per acre to $95.86, with the average capitalized value falling at $60.18. Still wider differences would have been found if the study had included any really poor farms. It is common knowledge that such a range of prices rarely, if ever, exists between farms actually sold, from which the conclusion follows that buyers commonly fail to get down to brass tacks on the question of what any particular piece of land can earn.

The method used in arriving at the capitalized value of the farms was fairly simple. For each farm the share of the crops commonly received by the landlord as rent was determined and the value from 1909 to 1914. To this amount was added the usual cash rental charge for pasture. From the total was deducted the landlord's expenses, such as taxes, building upkeep, insurance, and the cost of grass seed. The remainder was taken to represent the net income of the farm assignable to real estate. The capi-

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talized value of each farm was then calculated as that amount upon which the net income would represent a 5 percent interest return.

That taxes and other overhead costs have a sharp influence on the capitalized value of a farm readily follows, each dollar of taxes cutting down the capitalized value $20. The cost for upkeep, insurance, and depreciation of farm buildings works the same way, so that an overlarge investment may be a handicap.

While the foregoing method of valuation omits consideration of such factors as nearness to town, kind of roads, the desirability of the community, and other things which often bear on the sale price of a farm, the lesson stands out sharply that far greater attention should be given to earnings.

Diseases of the Teeth

Condensed from Pacific Rural Press

THE teeth of domesticated animals, when compared with those of man, are extraordinarily free from disease in the strict sense of the term. The great majority of the troubles arising from the teeth are due to causes which are either mechanical (irregular development, wear, etc.), or are situated originally in some adjacent tissue (pyorrhoea, caries, or other disease of bone, infection of alveolus from without, etc.).

In animals, disorders or diseases of the teeth are of great importance, because, in the first place, the digestive system, to function correctly, must have the feed suitably prepared in the mouth, and if the teeth are abnormal, proper chewing does not take place and digestion suffers as a consequence; and, secondly, most diseases or disorders affecting the teeth are associated with pain or discomfort, which results in absence of appetite, capriciousness in feeding, or other disturbances.

In certain cases, the incisor or molar teeth develop out of their normal positions in the jaw, with the result that perfect apposition between the upper and lower teeth is not possible, and the rate of wear is not uniformly distributed over the tables of the teeth. In other instances, extra or "supernumerary" teeth are formed; in the incisor region these are usually placed behind

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the arch of normal teeth, while extra molars may be found as projections from the gums on the inside or the outside of the line of normal teeth.

When the temporary teeth are shed it sometimes happens that the permanent teeth erupt irregularly on one side or behind the temporaries, and are distorted accordingly. This frequently happens in puppies, and to a less extent in the herbivora. In the former, trouble is likely to be experienced between 3½ and 5 or 6 months, and in young horses at 2½ and 3½ years of age. In such cases, it is necessary to extract any temporaries which persist, so that the permanent teeth can arrive in their proper places in the mouth.

In dogs frequently, in sheep sometimes, and in other animals less commonly, there may be a discrepancy in length between the upper and lower jaws. When the upper jaw is too long, the condition is known as an "overshot jaw," and when the lower jaw projects too far forward, it is popularly spoken of as an "undershot jaw." In bulldogs, pugs and other breeds of dogs with very short upper jaws the undershot condition is practically normal. While in certain breeds with extremely long upper jaws, such as the greyhound and show collie, overshot jaws are very common. In the herbivorous animals, which have to graze on pasture, both of these malformations are great disadvantages, since they hinder proper cropping of grass. Animals so affected do not usually thrive so well as others which are normal in this respect, and since the condition is *definitely* hereditary, they should not be used for breeding purposes.

In very many cases irregularities of development of the teeth do not produce any definite symptoms, and it is only by accident that they are discovered. As a rule, the nature of the irregularity determines whether the condition is serious or not. In animals with supernumerary teeth, chewing may not be affected until the extra teeth have grown to a large size, and even then they only cause difficulty in chewing when situated where they interfere with the closing of the jaws, or the movements of the cheek or tongue. These remarks also apply to teeth which are developed out of their normal positions in the mouth. Difficulty in chewing may also be brought about by persisting temporaries. Young animals which are changing their teeth often show a sudden loss of condition, and cease to feed with normal relish. Hogs and sheep at the age of ten months to about a year are notorious in this respect, so much that in most districts it is common practice for shepherds to cut turnips for them

when folded, as they are unable to bite the roots whole.

In most cases the offending tooth (or teeth) requires to be extracted. In the case of temporaries, no anaesthesia is needed, but where large permanent teeth have to be removed general anaesthesia makes the operation easier to perform and less of a shock to the animal.

Abnormal wear, which is due to malformations of the jaws, to excessive softness of the teeth, or to the direction of the teeth, is another mechanical cause of tooth disorder. The nature of the abnormal wear varies in different cases, and is productive of certain well-known conditions, as follows: (1) shear mouth, in which the molar teeth of the upper and lower jaws wear so that in time they appear like the blades of a pair of sheep-shears, the upper row being worn away on its inner border, and the lower ones along its outer border; (2) step mouth, where the cheek teeth, instead of being all at the same level, are arranged with some higher than others, somewhat like steps, a high tooth in the lower jaw being opposite a short one in the corresponding upper jaw; (3) overhanging upper jaw, which is where the first upper cheek tooth on either side is placed too far forward in the mouth, and does not come into accurate apposition with the tooth immediately below it, causing the formation of a hook. At the same time the last lower cheek tooth is situated too far back and also forms a hook; (4) curved tables, where the line of cheek teeth in the upper jaw shows a convexity in its centre, and a corresponding concavity exists in the lower jaw.

In most of these instances the animal affected (almost always a member of the horse tribe), instead of chewing its food and swallowing it in the usual way, rolls it around and around in the mouth until it collects into a sodden mass, often about the size of a couple of fingers, and puts it out of the mouth instead of swallowing it. This is known as "cudding" or "quidding," and the mass is known as a "cud" or a "quid." Salivation and dribbling of saliva from the mouth are also seen, especially when the irregularities in the teeth cause pain from bruising or scratching of the mucous membrane. Loss of condition eventually becomes marked, although many horses only lose condition slowly. In certain cases, hard foods may be refused, an animal eating grass, but leaving oats and chaff untouched. Large hard grains, such as whole oats, beans, peas, etc., may pass through the intestinal canal without digestion, and be recognizable in the faeces, and in these also can be recognized particles of

hay, chaff, or grass, etc., about an inch or an inch and a half long, having been swallowed without sufficient chewing. Pain may be shown when the hand is passed along the outside of the cheek, especially when pressure is put upon the line of teeth so as to press the mucous membrane against them, and the horse may resent having the teeth examined.

Rasping the teeth by means of a special tooth-rasp will reduce smaller irregularities, and bring the teeth back into their proper function when the alteration has not been great. When great changes have taken place, the overgrown teeth usually have to be cut with a tooth-chisel, with tooth-shears, or other instrument, while where one or two teeth have grown out of line of the jaw they are better removed, either by extraction by forceps or by being punched out through an opening in the bone from outside. These measures, and in fact most measures taken to remedy abnormalities or disease in teeth, should be undertaken by a skilled veterinarian.

Caries of the teeth consists of a destruction of the hard structures which form the teeth by micro-organisms usually of an acid nature. It is not very common among animals, especially among the carnivores, this being probably due to the fact that caries does not readily attack intact enamel, and in the carnivores the enamel forms a complete covering over the dentine and cement, whereas in other animals it does not. The condition is often present in the mouth of an animal for a very long time before it is suspected, and then it practically only shows signs of its presence by the extremely foul and persistent odor it produces. In advanced cases, however, proper chewing of the food becomes eventually impossible, and quidding is noticed. Sometimes a horse will suddenly stop feeding, and change the food to the other side of the mouth, and then resume. In other cases, a drink of cold water will cause a horse to snatch its head suddenly away from the trough, and commence working its jaws, as though to dislodge some offending particle of food from between the teeth.

Treatment consists in the removal of the diseased tooth or teeth by extraction.

Inflammations of the periosteum lining the root cavity of a tooth are common. They may be due to small particles of food getting forced down into the socket of the tooth, to fractures, or fissures of the teeth, to caries, tumor formation, depositions of tartar, and to certain specific diseases, such as actinomycosis, Stuttgart disease, strangles, etc.

The symptoms shown vary from a slight redness of the gum

around the root of the tooth, which is painful when pressed by the finger, to a large suppurating tract running alongside the root of the tooth down into its socket, and perhaps through the skin to the outside or into one or the other of the sinuses. Abscess formation in the tooth socket may take place, and the abscess may burst into the mouth, to the outside through the skin, or up into the sinus. In many cases there is a distinct bulge of the surface above the diseased tooth, which may give to the face a one-sided appearance.

The affected tooth or teeth must be extracted, and the areas of suppuration cleansed and curetted if necessary. The cavity usually has to be packed with antiseptic gauze afterwards for a few days until it begins to fill by healthy granulation tissue.

Odontomata are tumors formed in connection with teeth. They may occur in connection with the root of one tooth, or they may be found in the jaw, sinuses, or even involving part of the nasal passage, and be composite or compound, when multitudes of small rudimentary teeth are present. They cause swelling and bulging of the surface of the face, and can be treated surgically.

Toothache is a general term applied to the manifestations of pain in connection with the teeth. It is most spectacular in the dog, which rubs its mouth along the ground, paws at its nose or mouth, works its jaws, salivates, and may whine or moan.

It is caused by a great variety of different conditions, some of which have been mentioned previously. When an animal appears to be affected with toothache, steps should be taken to have its mouth examined by a veterinary surgeon, who will initiate the necessary treatment.

The Pennsylvania Game Commission's Plan

W. Gard. Conklin

Director of Refuges and Lands

THE Pennsylvania Game Commission two years ago instituted a plan to improve hunting conditions for farmers and hunters alike in the more heavily populated agricultural counties of the southeastern and southwestern sections of the State. This Farm-Game Refuge Plan was predicated on the belief that farmers would gladly cooperate with hunters if provided much needed protection against acts of vandalism by thoughtless or unscrupulous individuals. That the Commission was justified in this belief appears evident from experience gained since the program was put into operation, and especially during the open hunting season in November, 1937.

Although Pennsylvania farmers are not as a rule particularly game-minded, most of them are unquestionably wildlife conscious; that is, they take pride in having a reasonable amount of wildlife on their farms even though they have little or no inclination to hunt game for sport. They are genuinely conservation-minded and true sportsmen, for when winter snows make it difficult for self provides for wildlife is usually preferable to that they so wild animals and birds to secure food, there is scarcely a farmer who will not put out feed for them.

In this latter connection, however, they are apt to lose sight of the fact that food nature hergenerously scatter about. Most of the shrubs, weeds, greenbriars and other vines laboriously removed from fences and waste spots on farms supply palatable and nourishing food of inestimable value for wild creatures. Likewise, they provide necessary cover under which many species find shelter from predators and the elements. It is generally admitted that such vegetation is not ordinarily harmful to farm crops. Since it provides the right habitat required for valuable game birds and animals, as well as for insectivorous birds, it should not be destroyed.

The Game Commission, as is well known, is charged with the responsibility of administering the State's game resources, and to so manage them that a shootable surplus is available each year to supply sport for more than 600,000 hunters, many of them farmers. But what is often overlooked is that the Commis-

sion is likewise responsible for safeguarding insectivorous birds, and that it and its officers are as keenly interested in this phase of wildlife conservation as in the welfare of game. Farmers, whose crops would otherwise suffer from crop destroying pests, receive invaluable benefits from funds supplied by the State's hunting population. The Commission receives no part of its funds from General State Revenues, but is financed entirely by hunters.

Wildlife is considered a land crop similarly as are grains, vegetables, fruits and domestic livestock. The principal difference is that wildlife belongs to the public and should be available for harvesting by the public, under such restrictions and regulations, of course, as the Commonwealth finds necessary to prevent too close a harvest.

By a little careful planning, in connection with good farming practices, even the more intensively tilled farms can support a reasonably large game crop, and without detriment to the customary farm crops. Here the farmer's cooperation is needed to maintain, instead of destroying, natural vegetation required to provide the proper habitat for game. But the Commission realizes that the farmer's cooperation can not be expected unless his interests are fully safeguarded, which means cooperation on the part of all hunters, as well as the Commission.

To develop co-operation of all concerned, the Commission devised its Farm-Game Refuge Program, the essential features of which are here briefly outlined.

Accomplishments:

Thirty-seven projects, comprising 478 farms totalling 41,107 acres in 15 counties, have been arranged for. This necessitated securing 512 cooperative agreements from farm owners and tenants. Thirty of these projects were completely established and in operation during the hunting season last fall. 50% of the aggregate acreage had previously been posted against trespass, which also is a significant fact.

An exhaustive survey was made during and after the hunting season, by personal contact and through questionnaires, to determine the reaction of farmers and hunters to the program, and how it functioned when the hunting pressure was greatest. The findings were exceedingly gratifying. Since results from the questionnaires can be recorded more definitely than those from personal contacts, they will be cited.

A total of 186 replies were received from participating farmers, representing 32 projects, only 11 of whom indicated any dissatisfaction with the plan itself,

or the way it had functioned. Most of the farmers expressed complete satisfaction with the sportsmanlike manner in which hunters conducted themselves, and many added special remarks commending the efficiency of the Commission's patrolling officers.

Only 3 prosecutions having any direct connection with the projects were found necessary.

152 of the responding farmers signified their willingness to recommend the plan to others, which in itself is evidence of what they think about it.

A large majority of the farmers agreed to cooperate with the Commission or sportsmen in efforts to provide better food and cover for game, although, admittedly, not all were overly enthusiastic about permitting fences to remain unmowed.

Legal Status: Projects are established under provisions in the Game Law creating Auxiliary State Game Refuges, and are merely a sub-classification of the same. They are, in reality, Auxiliary Units, and the term Farm-Game Refuge Project is used merely better to identify them from other Auxiliaries, most of which are in forest territory.

Where Applicable: Because of the expense involved the Commission is unwilling at this time to authorize their establishment State-wide, and has consequently restricted them to 11 counties in the Southeastern section of the State and 11 counties in the Southwestern section.

Acreage Required: At least 300 acres of contiguous farms are required for any one project, but much larger areas are desired. Units of several thousand acres are preferable. Projects usually comprise a group of from two to thirty farms.

Application: The law requires that applications for the creation of Auxiliary State Game Refuges be filed with the Commission, and of course are necessary for Farm-Game Refuge Projects. Blank forms for this purpose are provided and will be furnished upon request.

Agreement Covering Hunting Rights: Only the hunting rights or privileges for the various farms are placed in the care of the Commission. A farmer's customary duties and privileges are not affected, except, of course, to the extent that he may not hunt within the small retreat areas set apart as refuges. The law requires the owner, or person having legal control, to execute an agreement vesting the hunting rights for his property in the Game Commission for a period of five years or more. A special form of agreement is provided for this purpose, is executed in duplicate, and when completely executed a copy is given to the farmer.

No Rental: No rental is paid. Farmers are more interested in protection afforded and clean sportsmanship than in receiving a few dollars as a rental. A nominal consideration of one dollar is mentioned in the agreement as a legal formality, but this is not actually paid.

Cancellation of Agreement: An agreement may be cancelled by the Executive Director of the Commission upon request when a good reason is offered. During the past 18 years it has been the policy of the Commission to cancel Auxiliary State Game Refuge agreements upon request of the landowner, supported by a good reason, and that policy likewise applies to Farm-Game Refuge agreements. Requests for cancellation of only 1% of these agreements have so far been filed, and in each case appropriate action satisfying the farmer was taken.

Safety Zones: No hunting, except by permission of the owner or tenant of a farm, is lawful within 150 yards of buildings. Safety Zone signs warning hunters of this fact are provided and posted by the Commission around buildings in accordance with the occupant's wishes.

Game Refuges: Small-sized refuges, from 2 to 50 acres (present average is 7⅔ acres), are established, within each project area, wherein hunting by any person is unlawful. The better game breeding and retreat spots are, with the farmer's approval, selected for this purpose.

The boundary line around each refuge is conspicuously marked, usually by a single strand of No. 9 wire, where there is no fence, and posted with appropriate State signs.

Refuges, as well as Safety Zones, provide protection against over-shooting and assure the preservation of ample seed stock for future breeding purposes. Game soon realizes where to seek safety, and quickly finds it.

Public Hunting: Hunting by the public is legal on all portions of a project area not set apart for Refuges or as Safety Zones. The Commission insists that at least two-thirds of each project area remain open to public hunting.

The landowner's right to hunt without a license on his and adjoining farms, except within refuges, remains unchanged.

Special Protection: Cooperating farmers and farm property are provided special protection from thoughtless or vandalistic hunters, especially during open seasons, usually through patrolling by Deputy Game Protectors. These deputies are employed by the Commission on a per diem basis at such times as their services are needed.

Signs warning hunters that certain acts are unlawful, and

citing others which either should or should not be done, are posted within project areas. The distribution of signs is made in accordance with the wishes of the farmer concerned.

Heavy penalties are provided by law for damaging property and other violations.

Natural Food and Cover: Since the game population of any area depends very largely upon the supply and distribution of desirable foods, as well as cover, efforts are made to provide as much natural food and cover as the potential game crop warrants. Farmers are asked not to cut all shrubs, vines and weeds along fences, or from untillable areas, such as briar thickets, ravines, spots where erosion is taking place, woodlots, etc. In many instances game food producing shrubs and vines can be planted on waste spots without harm to agriculture, but greatly to the benefit of wildlife.

Grains: Wherever possible, strips of grain near coverts are purchased from farmers at an agreed price. Or such strips are planted, subject to the farmer's permission, either by the Commission, sportsmen, or the farmer, for which services he is paid a reasonable price.

A mixture of eleven kinds of grains for game food plot sowing, suitable for Pennsylvania conditions has recently been developed. The various grains mature at different times and some of them remain on the stalk well into the winter months. It is expected that this mixture will be widely used. The formula, and where it may be purchased, can be secured from the Commission upon request.

Grain plots purchased or planted shall not be cut but must be left standing for game's use during fall and winter months.

Game Stocking: Project areas are given special attention with respect to the release of game for stocking purposes. All of the project areas are suitable for cottontail rabbits, and a majority of them for ringneck pheasants and bobwhite quail. The kind and quantity to be released annually on the respective areas will depend, of course, on the type of territory and the available supply from the Commission's game farms or by purchase.

Raising Game: Cooperating farmers, their families, or employes, if they desire to do so, will be paid a minimum of 35c per head for raising ringneck pheasants to six weeks of age and in good condition, with the understanding they will provide water and feed for birds which may remain near the coops for an additional four weeks. Eggs are furnished only upon application to the District Game Protector of the County concerned.

The Commission is greatly encouraged with the spirit of cooperation indicated by participating farmers and realizes its next big job is to gain the cooperation of hunters in improving food and and cover conditions. The Commission can not do everything which is needed to generally improve hunting conditions, so assumes the attitude that if hunters expect to get what they want they must be willing to work for it.

Orchard Irrigation in the Humid States

Condensed from American Fruit Grower

H. W. Gerlach
Agricultural Engineer

SUPPLEMENTAL irrigation to carry orchards through short periods of drought during crucial stages in the fruit development periods, is finding increasing use in eastern and middle western orchards. Average rainfall in these territories is generous but distribution is such that one to two and two to three weeks drought periods, particularly during times when fruits are filling, seriously affect the yield.

Far western orchardists rely almost entirely on irrigation and due to splendid systems and ample water supply they have accurate control over moisture to meet plant requirements. In sharp contrast to this system we find eastern growers have always been confronted with the spectre of drought periods in the land of abundant rainfall.

The University of Minnesota has released figures (Table I) showing the number of rainless periods of one to two and two to three weeks duration between April and October. Bear in mind when reading the table that these drought periods occur in decidedly humid states where rainfall averages over 30 inches per year.

Careful analysis of this table shows that the drought periods are of sufficient duration to cause deleterious effects not only on the fruit yield but also on root growth of the trees. The value of irrigation during the periods given in the table could not be measured entirely by increased yields. We must in addition take into consideration the beneficial effects upon quality and also upon the prolonging or hastening of the harvest periods in order to meet better market conditions.

Reprinted by permission from American Fruit Grower, 1370 Ontario St., Cleveland, Ohio, April, 1938

Rare, indeed, is the orchard that does not have available either ponds, lakes, streams, or water-bearing strata below the ground that can be used to furnish water for irrigation.

Damming of dry run gullies having drainage areas of from 20 to 100 acres often proves to be one of the cheapest means of storing water. By choosing watersheds that have gradual slopes to prevent rapid run-off with resulting excessive erosion, the orchardist is often able to construct a farm pond that will have storage capacity ample to carry his orchard through ordinary periods of drought.

A splendid example of what can be done in this line can be seen on the Guy Beauman Orchard which is located at Tunnel Hill, Ill. The orchard consists of between 400 and 500 acres, almost equally divided between apples and peaches. It was found that the fruit yield in this orchard was often seriously affected by drought that occurred consistently during the latter part of May and the first part of June.

With almost the entire apple crop composed of early varieties, such as Transparent and Duchess, whose picking dates usually terminate about June 20, a loss in yield from 20 to 50 per cent was suffered due to lack of rainfall. With the rainfall average for the territory of from 36 to 42 inches per year, it is easy to see that it might be felt that irrigation would be totally unnecessary.

In 1935 construction of a sizable reservoir was started on this farm. By 1936 the dam was completed and approximately 10 acres of a large gully on the farm had been converted into a lake. The first part of the dam was constructed with horses and a light tractor and small scrapers. Following the first season of pumping it was apparent that a good deal larger amount of water could be profitably used, and the county commissioner was prevailed upon to supply the heavy duty county tractor and large earth-moving scraper.

With this equipment approximately five feet was added to the crest of the dam, and during the 1937 season pumping was started on May 25 and continued right up to the picking season, which was completed around June 20. A four-inch pump is used and an eight-inch main carries the water to lateral distributing lines. Irrigation is by means of flooding. The water is taken from the laterals and placed into contour ditches that run around the orchard hillsides. The water is led from one of these contours to the next contour below it, and by means of slight ditches it is directed around each tree.

It is figured that approximately

1000 gallons of water is pumped each minute and that approximately 30,000,000 gallons of water was added to the orchard during the 1937 season.

The gasoline engine used to operate the pumps consumes approximately three gallons of gasoline per hour, costing 12 cents per gallon. Running for the 25 days of the pumping season, the fuel cost runs slightly over $100. The cost of the pumping plant and using an industrial gasoline motor to pull the pump ran in the neighborhood of $1,000, and approximately $3,000 was required to set up the pipe distributing system.

Very careful test records were kept on the trees that were watered, and checking back on blocks of unirrigated trees showed an increase in volume for fruit for the irrigated trees of from 25 to 50 per cent. Slightly over 100 acres of trees were under irrigation. The increase in apple yield plus the price advantage of getting the fruit on the market at an earlier period, with a resulting higher price, has paid dividends that have paid out the entire cost of the installation during the two years that it has been in operation.

Construction of a pond for the storage of water is a job that any orchardist can safely undertake if he will carefully adhere to certain principles. It should always be remembered that the storage of water behind an earthen dam is a job that will meet with certain failure unless definite hydraulic principles are observed. The smallest seam or crack that is left in the base of the earth fill will permit a small trickle of water which little by little will carry away enough soil to cause final destruction of the entire fill.

The following salient points should be remembered in the construction of the dam:

1. Carefully remove all rubbish and sod from the entire area where the earth fill will be made.

2. Slope the sides of the gully walls so that no overhanging banks are present.

3. Width of the fill at the base should be four times the height of the water to be stored. Thus a 20-foot high dam will have a base width of 80 feet.

4. Bring the fill up uniformly, making one-foot layers over the entire area of the fill. Keep trash out of fill.

5. Have the crest of the dam at least three feet above the water line when full.

6. Provide a generous emergency spillway to carry excess water during times of flood.

In making the fill it is important that no trash or rubbish or dead grass be used. This material will rot in time, causing seepage lines. With many types of soil it

is desirable to cut the core trench completely across the dam site and to fill this with a good clay or other impervious material and to tie it into the earth fill proper. This core trench serves as a key holding the dam to the dam site and also preventing seepage underneath the earth fill.

A common failing of inexperienced operators in constructing dams is to start the fill by building a roadway through the center of the dam and spilling the earth either side of the center line. In doing this settling cracks later appear, and also there is a tendency of the larger particles of material to roll to the bottom forming a line of coarse material immediately next to the dam site and thus forming an excellent seepage line.

TABLE I—Number of Rainless Periods in Humid States Each Year Between April and October

State	Duration 1-2 Weeks	2-3 Weeks
Iowa	8	1
Michigan	7	1
Minnesota	6	2
Wisconsin	6	1
Illinois	6	1
Indiana	6	1
Ohio	5	1

Tractors of the type so commonly employed in orchard cultural practices furnish ideal power to be used in constructing ponds. Oftentimes with rollover scrapers it is practical to scrape out considerable of the dam material from the storage space above the dam site, thereby increasing the storage capacity of the dam. A 30-horsepower tractor pulling a one cubic yard scraper will move approximately 30 cubic yards of earth per hour. Thousands of earth filled dams of 2,000 cubic yards fill show that with this size of tractor a similar dam can be constructed in less than a week of operation time. A team pulling a five cubic foot slip scraper will move approximately 10 cubic yards of earth per 10-hour day, so it is apparent that tractor power is by far the most economical power to be used in constructing any sizable fill.

Farm power contractors are located in most orchard areas and as these operators are usually equipped with heavy duty tractors and have the full complement of equipment necessary for the construction of dams and terraces, it is often practical to hire them to construct the dam. The usual rate charged by these operators is $2.50 per hour for the tractor and operator, when working on a one cubic yard scraper. Assuming 300 cubic yards of earth moved per day, the cost per yard of earth moved is less than 10 cents. A quick study of the cubic yards of earth necessary to fill the gully will give a good idea of the cost of the completed dam, if a cubic yard cost of 10 cents is figured.

Ample provision must be made in constructing the farm pond for taking care of excess water during periods of floods, and emergency spillways often prove a practical means to this end. These spillways may be covered with masonry or concrete, and in some cases concrete tubes are constructed around or underneath the dam.

Methods of applying the water to the orchard are numerous and the particular means chosen will be dependent upon whether the system will necessarily be permanent or portable. Common methods in use at the present time may be roughly classed as follows:

1. Pipe Systems
   a. Revolving spray sprinklers
   b. Eyelet and porous hose
   c. Overhead or surface perforated pipes
2. Surface Irrigation Systems
   a. Furrow
   b. Flood
3. Subsurface Irrigation Systems
   a. Pipe
   b. Ditch

The system chosen will vary greatly with the particular topographic lay of the orchard and the money that is available to spend on the system. Practically any of the systems may be adapted to all orchards, except that the flooding type or furrow row systems require either level ground or the construction of contour terraces.

Due to the short pumping season usually necessary through the humid states, it is desirable to keep the pumping plant investment overhead at the very lowest figure possible as otherwise the overhead charge will be excessive compared with the amount of water pumped. Many orchardists are finding that their tractors form desirable power units to hold a pump, as the tractors are usually not seriously needed on other work during the pumping season. Tractors equipped with belt pulley drives or rear power take-offs are particularly suitable for this type of operation, and orchardists fortunate enough to be using Diesel tractors in their operation are able to keep their power costs for pumping extremely low.

In conclusion, it is safe to say that the money spent on supplemental irrigation systems pays big dividends in increased fruit production and improvement in cultural conditions of the trees. Freedom from worries during short drought periods is possible, and while not 100 per cent of the orchard acreage can be successfully irrigated, it is safe to say the majority of the orchards in the humid states are so situated that splendid results can be obtained.

Some Nutritional Requirements of the Tomato

Condensed from New Jersey State Horticultural Society News

V. A. Tiedjens

TOMATO yields and tomato quality are closely associated with the nutritional status of the soil on which they are grown.

An examination of tomato fields following the August storm this year indicated that fields where the soil was in a high state of fertility recovered and were not as severely damaged as those where soil conditions were not suitable for tomatoes. Tomato plants on the heavier soils likewise were less damaged than those on the lighter soils. Generally, the lighter soils do not have the potential fertility that the heavier soils have and crops do not make a satisfactory recovery unless fertilizer is applied.

Many tomato fields made an excellent growth early during the past season, but stopped growing rather suddenly. There was plenty of moisture in the soil due to a number of fairly heavy rains. Where the fertilizer was all put on previous to setting the plants the moist weather made it possible for the plants to take in abundant plant food, with the result that they became very soft and succulent. Apparently the available nitrogen which had not been used by the plants was removed from the vicinity of the roots, through leaching by the heavy rains, with the result that the plants suddenly stopped growing and in many cases showed nitrogen and potash deficiency symptoms. Where the fertilizer was applied in several applications, as side dressings, this condition did not occur. Apparently, on the lighter soils, it is necessary to feed according to the rainfall. Heavy rains may leach away much of the nitrogen and potash and unless it is replenished the plants show the effects of deficiency very quickly, particularly if the weather turns dry and hot. Irrigation does not help much unless more fertilizer is applied.

Calcium and magnesium are as necessary as nitrogen, potash and phosphates for the growth of a big tomato crop. If lime has not been used in the past, at least

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one-half ton should be used even though the pH may be satisfactory. Where a high (12 per cent) phosphate fertilizer is used or the grower applies superphosphate in addition to his regular fertilizer it may not be necessary to use lime as freely. One twelve acre field showed magnesium deficiency symptoms so badly this past season that many leaves dropped off the plants before a top dressing of magnesium could be put on. It is difficult to put these materials on so that they will correct a situation quickly unless a good rain gets the material into the soil where the roots will get it. Liming materials should be applied before the crop is set so that they are mixed with the soil where they are accessible for the roots.

Lime and fertilizer experiments with tomatoes conducted by the Vegetable Production Department of the Experiment Station at New Brunswick for the past three years have shown an increase of three to four tons of tomatoes per acre in favor of lime where lime and no lime treatments were compared. Magnesium limestone has increased the yields more than high calcium limestone by one to two tons in each of the three years.

Experiments have also shown that where the calcium content of the soil is raised, potash may become deficient, because of the more rapid growth the plants require more potash. It was found that where the calcium content was maintained at a good level for tomatoes there should be at least one hundred pounds of potash available per acre for the crop. This is equivalent to one ton of fertilizer having five per cent potash or fifteen hundred pounds of a seven per cent potash fertilizer. If the season is favorable for a twelve to fifteen ton crop of tomatoes even more potash may be needed. On the fertile soils, fifteen hundred pounds of a fertilizer carrying seven per cent potash may be sufficient. On worn out soils it probably would not be sufficient. For this reason abandoned fields brought into production with a liberal application of lime will often show potash deficiency symptoms.

Growers have access to a number of different kinds of liming material. Oyster shell, commonly used, is a high calcium material, but should be very finely ground. Continuous use of this material will result in magnesium deficiency.

Ground limestone when finely ground is very satisfactory. This can be obtained in either the high calcium or high magnesium form. Where the soil test shows a low magnesium reading, the high magnesium limestone should be used. Limestone is about two-

thirds as effective as the hydrated or agricultural limes. These also can be bought in either the high calcium or high magnesium form.

The diversity of vegetable crops with their specific requirements makes it difficult in some cases to follow a definite liming program. The combination of crops having high and low pH requirements makes it necessary to maintain a high calcium level with other materials than lime. The sixteen and twenty per cent grades of superphosphate, gypsum or calcium nitrate help to maintain a satisfactory calcium level. Tomatoes require considerable calcium, but will not grow on as acid soils as are necessary to control pox on sweet potatoes, but some growers try to grow both crops in the same rotation. It is possible in such rotations to use superphosphate or gypsum, but the cost will be greater and the crop of tomatoes will not be as good as where more lime can be used. There are cases where the pH is satisfactory, but the calcium content is too low. Gypsum would be a satisfactory substitute for lime, but due to the difficulty of getting the material the grower must depend on superphosphate or calcium nitrate. Superphosphate contains considerable gypsum.

Organic matter experiments conducted the past two years at New Brunswick showed that where the field was planted to cover crops or corn the previous year, the yield of tomatoes was increased by four tons per acre. Where cultivated muck was added to supply organic matter the yield was not materially affected. Cover crops apparently build up organic plant food which breaks down when plowed under and feeds the tomato plants gradually throughout the season. The yield on all the cover crop plots averaged 14.5 tons as compared with ten tons where only lime and fertilizer were used and 7.5 tons where only fertilizer was used.

More Storage Space in Barn

Condensed from The Michigan Farmer

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THE laminated rafter is made up of a number of layers of narrow boards bent to the desired curvature and nailed together. Their use to form the pointed arch or round roof offers several advantages which will be discussed in this article. They are most useful in constructing barns and implement barns where unobstructed storage space is desired. A brief of past and present needs may serve to show the reasons for more widespread adoption of the laminated rafter type of construction.

Barns built in earlier days were built with heavy square timbers framed together to obtain strength. Gable roofs were commonly used. To obtain stability it was necessary to cross the storage space in the barn with the timbers, and the gable roof was low. With improved mechanical hay handling equipment considerable inconvenience was experienced in getting hay in and out of the barn. This type of structure was followed by the plank or balloon frame with gambrel roof, self-supporting in many instances. Improvement in storage space was obtained but not without considerable expense for both material and labor in construction.

The typical early barn also had one or two driveways between the framed bents. Though useful in various ways, principally for storing bundle grain in the mow before threshing, much of the storage space above the drives was lost. In barns being built at the present time the tendency is to eliminate drives and obstructing frame-work and make use of the maximum volume of storage space.

For the newer type barn, therefore, the laminated rafter method which supplants timber and plank framing has many advantages. The material may be cut from native trees of smaller size and used rough-sawed which makes for economy. The system of laying out and construction is simple, since the rafters are made in multiple in a single form. Little skilled work is required, except for laying out and erection. The form of the roof, round or point-

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ed arch, makes it resistant to wind. The storage space is entirely free from obstructing timbers and the volume of storage which can be obtained from the floor above the animals is sufficient to store roughage and bedding for these animals.

With the entire floor and storage space used for animal shelter and feed storage, it may be desirable to provide room for the few operations, once done on the barn floor, and machinery storage in a separate building. Laminated rafter, round roof construction provides separate space at low cost.

The elasticity of material which permits construction of the curved rafter also permits sagging of the roof-line unless the units in the construction system are tied together to obtain rigidity. From a mechanics standpoint the upper structure of the barn may be considered as a shell having rigid ends to which the curved roof sheet (rafters, purlins and roofing) is attached. Joining the ends at the highest point is the heavy ridge used in this construction. Ends, ridge, and roof-sheet are securely tied together and to the foundation to form a strong shell. To give added strength and insure against sagging, a system of cable reinforcing has been devised. In this development the ends of the ridge and the lower corners of the structure at the plate are considered as fixed points. Any sagging of the ridge in the center will be downward, which would force the rafters outward at a lower point. A cable (inextensible) is attached to the ridge at one corner and to the sill at the opposite end. It is also wired to the rafters and strung tightly. Any outward movement of the rafter and corresponding downward movement of the ridge will therefore be resisted by the cable, which is tight, inextensible and rigged to approximately the arc of a circle with the ends fixed.

Before using the cable system on a full-sized structure the principle was tested on a one-sixth size implement barn constructed exactly like the full-size building as to pieces, nailing, and bracing. Small wire reinforcing was then installed and a test-load applied by adding 10-pound bags of sand. A check was kept on roof sag and distortion, roof sag proving to be the criterion of the value of the system. Without reinforcing, a uniformly distributed load of 90 pounds on the 6x10 feet structure proved to be about the limit without undue distortion. When the cables were installed, the ridge was given ¾-inch camber or rise in the center. With a uniformly distributed load of 2,000 pounds or 200 ten-pound bags, the camber of center rise was reduced to ⅛-inch. Just what relation the load on the model bears

to that on the full-sized structure is somewhat problematical, but the load applied on the small model was equal to 36.6 pounds per square foot over the floor area or projected roof area of the structure. The load concentration was approximately 60 pounds per square foot or about twice the actual allowance made in the design of full-sized buildings for combined snow and wind load.

Laying out the forms for the construction of the curved rafter is relatively simple, but it is necessary to provide a rigid, level surface on which to work. In barn construction the foundation and walls are first built and the floor laid. The floor provides an excellent base for the forms and the rafters are at the point needed when finished. Where a floor is not used it is necessary to provide a base of plank laid on cross pieces of "2x6's" spiked to posts driven solidly into the ground.

In laying out the curve of the rafter, chalk-lines are arranged at right angles. One of these lines forms the center line of the building and the other the base or line across the top of the plates on which the rafters are set. For round-roof construction, the intersection of these lines is a center from which the arc of the rafter is described using one-half the width of the building as the radius. For the barn roof a radius of three-fourths the width of the building is usually used and the center for the radius line is on the base line at one-quarter the width of the building from the center line.

After the arc of the rafter is described, a row of "2x4" blocks about 2 feet apart with ends on the line is spiked to the base. These form the outside of the rafter. A similar row of blocks is set opposite to these, 6 inches from them where 5 laminations are to be used. Between these blocks wedges made from "2x4's" are used to force the layers together, after which they are spiked from each side about 8 inches apart with the largest spikes, usually 30-penny, which can be used without excessive splitting of the material. The ends may then be sawed with a crosscut saw on the base and center line. Some builders using smaller nails start with 2 or 3 layers, nail and add other layers with additional nailing.

Another method of rafter construction may be used. All layers are placed in the form and held snugly with wedges. A stop block is provided at one end of the assembly and a truck jack, set against another block as a base, is extended against the end of the inner layer forcing it outward all along the rafter and compressing the set against the outside row of blocks, after which they are fastened.

For erection a movable scaffold 8 feet by 10 feet or 10 feet by 12 feet, with a plank platform 4 feet below the ridge, has been found usable. In fact, this scaffold is the only one necessary. In erecting, the upper ends of the first pair of rafters are raised to the platform with rope and pulley and the first section of the ridge, consisting of a 6 foot and 12 foot length spiked together, are also taken up. The first pair of rafters is then set and stayed in place with one end of the ridge between rafters and the opposite end supported on a post. With the ridge in place, additional rafters are set up and the scaffold moved. Since the ridge is double, starting with a half and full length of material, full length material is easily added making joints at each half length of material as the work advances.

Roof boards of 1 inch by 6 inch or 1 inch by 8 inch, or 2 inch by 4 inch purlins, spaced approximately 18 inches apart, may be used for roof supports. Corrugated steel roofing or V-crimped roofing may be used, with preference being given to corrugated, since bending slightly stiffens the sheets. With roof boards a tighter roof may be obtained, but 2 inch by 4 inch purlins are economical and furnish a solid nailing base. Where other than steel roof is used roof boards must be spaced 2 inches or less apart.

An effort has been made in this article to cover essentials only for this type of construction. Additional use of the system will undoubtedly develop many angles of the problem.

Fertilizers for the Dairy Farm

A. R. Whitson and F. L. Musbach
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IT is of the greatest importance to save all plant food in manure and to use it to the best advantage. It is also necessary to so till the soil as to produce the best seed bed and to kill weeds to save moisture. In addition, the proper use of commercial fertilizers to balance the plant food of the soil and manure is important even though the amount that can be used is small.

High yields per acre of corn, grains, alfalfa, and pasture are the best means of reducing costs of dairy feed. In order to get high yields we must make the best possible use of the farm manure

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and supplement it with other fertilizers where needed.

It is easier, of course, to keep the soil fertile under a system of livestock farming than it is where crops are sold directly, but even under livestock farming there is a constant loss of plant food in the sale of products and in the way manure is handled on many farms. And these losses must be made good in order to maintain yields. It costs less to buy the plant food than it does to buy additional feed, or to increase crop acreage.

The composition of manure depends on: (1) the age and kind of animals producing the manure, (2) the amount of litter used, (3) the ration fed, and (4) the way the manure is handled.

Fresh manure from dairy cows contains about 75 per cent of the phosphorus and nitrogen, and practically all of the potash in the feed consumed but there may be a loss of nitrogen and potash before the manure is mixed in the soil. There is always a danger of loss by leaching of both potash and nitrogen and furthermore nitrogen escapes into the air as ammonia. The table shows the relative amounts of three important elements in both the solid and the liquid portions.

Potassium and nitrogen are found largely in the liquid portion while phosphorus occurs largely in the solids. While the use of a cistern to collect liquids might seem to be an ideal method of saving valuable plant food elements, yet large losses of nitrogen are likely to occur in the cistern as well as after field applications have been made. In general, the most practical plan is to use enough bedding to absorb the liquid.

Both as a means of saving work and preventing losses of plant food it is best to haul and spread the manure directly from the stable. If the ground is too soft to use the spreader, the manure should be put in fairly deep compact piles so that rain will not cause leaching before the manure is spread. These piles may be along the sides of the field to which the manure is to be applied or left in the barnyard.

When manure is piled it ferments and part of the nitrogen

Plant Food in Fresh Manure

	Nitrogen in		Phosphorus in		Potassium in	
	Solid	Liquid	Solid	Liquid	Solid	Liquid
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Horse	62	38	100	0	56	44
Cow	49	51	100	0	15	85
Pig	67	33	88	12	57	43
Sheep	52	48	95	5	30	70

changes over into ammonia. When manure from such a pile is spread and exposed to the air, especially on a dry windy day, the ammonia escapes rapidly into the air, resulting in a loss of nitrogen. Under these conditions, therefore, manure should be worked into the moist soil just as soon after spreading as possible. A good practice is that of disking in during the afternoon of the same day the manure is spread in the forenoon.

Clover and alfalfa are benefited by top-dressing from the potash and the phosphorus in the manure, but these crops can secure nitrogen from the air. New seeding may well be top-dressed in the late fall or winter as a means of furnishing plant food as well as a protective covering.

Hauling out manure, however, in the late summer or early fall results in heavy losses of nitrogen unless rain quickly follows. As a rule, most of the manure may better be used on the corn or cultivated crops, hauling it out directly from the stable or, if applied in the spring, working it into the soil immediately after spreading.

Frequent light applications of manure are advised. At the Spooner Experiment Station, considerably larger returns per ton of manure were secured where four and a half tons were applied every third year as compared to nine tons. Four and a half tons per acre gave a crop increase valued at a little over $3.00 per ton of manure as compared to approximately $2.00 per ton with the nine ton application. "Stretching the manure pile" therefore, under present conditions particularly, is sound practice.

Organic matter not only increases the water holding capacity, improves the tilth, but also absorbs plant food which would be lost by leaching. Manure adds some organic matter but not enough. In order to replace the amount lost by cropping, plowing under a second crop of clover or alfalfa is advised. When fed through livestock, nearly two-thirds of the organic matter is destroyed. A clover crop of, say a ton of hay per acre, will when plowed under, furnish as much organic matter as the manure produced by the feeding of three tons of hay which would be five or six tons of manure.

Even on dairy farms, losses of plant food occur. In the sale of 7,500 pounds of milk, the production of an average cow for one year, phosphorus loss equals that found in 100 pounds of 16 per cent superphosphate. A 1,000 pound cow, when sold, removes practically the same amount. These losses for any one year may not be large, but over a period of years they become significant.

Our Agricultural Experiment Stations

Condensed from The Nation's Agriculture

Jacob G. Lipman

Director, New Jersey Agricultural Experiment Station

MANY decades before the advent of organized research, farmers in many countries were accumulating important information on which agricultural progress has been built. Intelligent farmers in all lands learned much and forgot much. One may well think with deep regret of the valuable knowledge that was gained and lost because the means for recording and disseminating new knowledge were not available.

In his book on Soils, Dr. Hilgard speaks of the relative permanency of irrigated agriculture. His statement suggests to us the longevity of the agriculture of Babylon, Egypt, India, Southern China, portions of South America and of other countries in different parts of the world. To be sure, the soil chemist will tell us that the constant leaching to which soils of the humid regions are subjected supplements the loss of soil constitutents brought about by the removal of crops and animals. And so in humid soils there is the progressive depletion of the supply of plant nutrients, accumulation of soil acidity and the impoverishment of the land and its inhabitants.

In countries of limited rainfall, there is the accumulation rather than the dissipation of soluble salts and other compounds. In fact, the accumulation of soluble salts leads to the development of saline and alkali soils. In other words, from the standpoint of permanent agriculture, too much soil washing and too little soil washing are both undesirable.

However, the irrigated agriculture of the countries referred to above was less destructive of the plant food capital of the land, and some of the ancient civilizations lasted for hundreds of thousands of years because their soil resources lasted for that length of time. When the soil capital in any country became depleted, when soil deficiencies developed, there were corresponding deficiencies in crops and in animals. Vegetation and animals dwindled in size and developed deficiency diseases. Wars and migration were the aftermath of soil depletion.

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Modern examples of what dwindling soil fertility may mean are not wanting. For instance, the writer was told, when he traveled through the Highlands of Scotland two or three years ago, that whereas 100 years ago an acre of land supported two sheep, now it requires two acres to support one sheep. At that, the animals are smaller and their wool is shorter and coarser. There has been a startling increase in soil acidity, and a corresponding loss of lime and phosphorus so essential for the building of animal bodies.

One may readily think of the three-field system so widely employed in Europe as well as in the Colonial days in North America. The three-field system involved the maintaining of a third of the crop land in fallow for the sake of accumulating enough available plant food for the growing of two crops in three years. When the old learning of the Romans was revived, and legumes introduced in place of the fallow, these crops were designated as fallow crops. Farmers of Western and Northern Europe learned again, what the Roman farmers had learned many centuries before, that legumes may be used for maintaining the nitrogen and organic matter supply of soils.

There is no need to cite other examples of what the method of error and trial had done for agriculture. What was sound remained. Some of it was forgotten. At the same time much was forgotten that did not deserve to be remembered. But the method of trial and error is an expensive one. There is too much lost motion and too much wasted effort in following this method. This the farmers of Europe and North America recognized nearly a century ago.

The beginnings of experiment stations may be found in France, in England, in Germany and in the Scandinavian countries soon after the end of the Napoleonic Wars. Progressive farmers began to appreciate more and more the value of systematic search for answers to difficult questions. The experimental method was adopted and funds and personnel were provided for carefully planned investigations concerning soils and fertilizers, concerning the selection of better plants and their improvement by breeding, the introduction of new varieties of plants, the use of chemicals to combat damage by insects and plant diseases.

The educational process proceeded with increased force until popular pressure became strong enough to assure the establishment of agricultural experiment stations in the United States. The first of these was established at New Haven in 1875. North Caro-

lina and New Jersey followed soon. Then came the enactment of the Hatch Act in 1887. This provided for an experiment station in every state in the union. These stations recently celebrated their 50th anniversary. Hence, this is an opportune time for asking what have they done. What service have they rendered? What contribution have they made to the development of a more sound and prosperous agriculture in the United States and in other countries?

We may attempt to answer these questions from the point of view of soils, plants, animals, the control of diseases and parasites, the use of power in agricultural production, the processing of agricultural commodities, the use of crop produce as raw materials in the industries, and the whole range of economic and social factors that directly concern our rural life.

As to soils, we know that those soil areas that have been farmed for the longest time in our history often show the highest yields per acre. For instance, the New England States or the Middle Atlantic States may claim high yields per acre of general crops, hay, vegetables and fruits. In other words, they have been able to offset soil depletion by the use of chemical fertilizers, lime, green manures and crop rotations.

Such striking examples as the average production of potatoes equivalent to more than 200 bushels per acre in Maine, or the increase in yields in New Jersey from an average of 100 to about 160 bushels of potatoes per acre may suffice to indicate how modern methods of soil management have come into being, thanks to systematic research related to the chemistry, physics and microbiology of soils. We are more or less familiar with crop production contests in which some of the competitors have been able to produce 500 bushels of potatoes per acre, more than 150 bushels of corn, 50 bushels of wheat, more than 2 bales of cotton, and yields of other crops which seem almost impossible.

When we think of plants, we realize how much improvement there has been in quality from the standpoint of disease resistance, yield per acre, length of staple in cotton, color and flavor in apples, vitamin content of vegetables, and other qualities which make possible the successful marketing of quality products. Plant breeding has made possible the establishment of disease resistant varieties or those with a shorter growing season; thus the northern limits of the corn belt or the spring wheat belt have been substantially extended.

It is a far cry from the dairy or beef animals of a hundred years ago and those of today.

The size and quality of the modern steer were not even dreamed of a hundred years ago, neither was the dairy cow with records of more than a thousand pounds of butterfat per annum, and yields of milk approximating 40,000 pounds per annum. We no longer wonder at the 300-egg hen. Nor are we surprised when we hear about the ton litter of pigs.

If space were available, one might say a good deal about bovine tuberculosis, Bang's disease, Texas fever, hog cholera, infectious bronchitis and any number of other diseases and parasites of animals that we have learned to control entirely or at least in part. The present-day supply of high quality meat products would not have been possible without the systematic studies and investigations of our experiment stations and of the Federal Department of Agriculture.

We know a great deal more about co-operatives, about transportation, distribution, storage, quick freezing, canning and drying than we did a few years ago. The mere mention of these topics suggests to us two generations of intense study, of learning, of adaptation and change.

The agricultural experiment stations have been the farmers' tools and the farmers' service agency in keeping abreast of the the economic and industrial changes in our cities and non-agricultural communities.

Pigs' Feed

NEED for grain substitutes in feeding hogs in England has resulted in the successful use of potatoes, sugar beets, artichokes, mangolds, rape, tapioco flour, sago pith meal, rice products, cane molasses, millets and whey, along with many kinds of pasture grasses and forage crops.—*The Furrow*

Dangerous Spring Plants

Condensed from The Indiana Farmer's Guide

Oliver C. Lee
Purdue University

FARMERS can not afford to feed their live stock throughout the winter only to find them dead after the first few days out in the pasture. Losses of this nature have been experienced by many farmers during the mild days of spring and much of the blame can be contributed to poisonous plants that make their appearance in the early spring.

Perhaps you have lost pigs down by the creek or on overflow land. If the animals developed staggers and threw their heads backward in a peculiar fashion, look for cocklebur sprouts. Investigations have shown that during the succulent two-leaf stage when the shoots possess a pair of grass-like leaves, cockleburs are fatal to live stock, particularly pigs. If some of the animals are still sick, feed them cream, fat or oil and they may stand a chance of recovering.

Cocklebur sprouts are not the only plants found along streams and in wet places that may cause trouble. There is a parsnip-like plant frequently but incorrectly called wild parsnip, having tuberous roots and purple shoots, that is exceedingly dangerous to both man and beast. Upon uncovering the fleshy roots, which resemble a cluster of small sweet potatoes, cut them in half and note the peculiar odor of the glistening yellow juice contained therein. This material is the poisonous principle which is so potent that it is said the Indians used a piece of root the size of a walnut for suicidal purposes. The plant is water hemlock, the most poisonous of all plants. Unfortunately, the poisonous material enters the sprouts causing the young plants to be dangerous as well as the roots. Poisoning to live stock usually occurs in the spring due to grazing on the tender shoots or eating the fleshy roots that have been exposed by freezing and thawing during early spring months.

There is still another species found along streams, a plant known as cursed crowfoot or buttercup. It is poisonous to all hogs regardless of age. It causes the animals to go blind. The

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cursed crowfoot can be recognized by its yellow, buttercup-like flowers. The plants contain an acrid burning juice which causes the poisoning.

If the trouble has not been on moist land, but in the field, look for evidence of grazing on wild cherry sprouts along fence rows. Or perhaps the wind has blown down cherry limbs where live stock could reach them. Both the young sprouts and the wilting leaves of the common cherry contain prussic acid, one of the deadliest and quickest-acting poisons known. Cherry sprouts and broken branches of cherry trees should be kept out of the reach of all live stock.

In wooded pastures the most common trouble maker is the Dutchman's breeches, so-called because of the odd pantaloon-like shape of the dainty white blossoms. The roots are of the bulb-type and contain a poisonous principle causing trembles and death to cattle, when turned into the woods so early as to be practically compelled to graze on this, the only green in sight. Growing in company with the Dutchman's breeches may be found the handsome blue-flowered species called dwarf larkspur, also possessing a bulb and that poisons in much the same manner as its companion plant.

There are a number of additional species capable of causing live-stock poisoning during spring but the ones mentioned have proved to be the most dangerous. Early pasturing before considerable grass is available is dangerous and should be practiced but little.

How to Control Garden Insect Pests

Condensed from Eastern States Cooperator

Neely Turner

Assistant Entomologist at the Connecticut Agricultural Experiment Station

AS it would not be practical to attempt discussing the entire field of vegetable insects in this article, let's concentrate on some of those which cause the greatest damage.

Cutworms. These insects are the caterpillars of several species of a large group of moths. They are usually inhabitants of grass lands, but occur on most truck farms. Some of the cutworms have a climbing habit and damage the fruit or foliage of plants. Others cut off the plants near the surface of the ground. Damage is often done to transplanted cabbage and tomatoes soon after they are set in the field.

The most satisfactory control measure is the use of poisoned bran mash, composed of 20 pounds of wheat bran and one pound of *Paris green,* mixed dry and then moistened just enough so that the finished bait will not drip when squeezed in the hand. *Paris green* is very poisonous and care should be taken not to breathe it during mixing and to wash the hands thoroughly after handling it. This amount is enough to apply broadcast to one acre before plants are set, or to treat two acres by hill applications (one pinch to a hill). The bait should not actually touch any of the plants, as *Paris green* is injurious to many kinds of plants.

Cabbage Maggot. This pest attacks early cabbage, cauliflower and related plants. Eggs are laid in the soil close to the stem of the plant. The maggots hatch within a week and immediately attack the seedlings. In heavy infestations the seedlings usually wilt and die. A second brood appears about the middle of June, but does little damage to cabbage. This brood often seriously injures turnips and late radishes. It is advisable to rotate cruciferous crops so that plants will not be set in heavily infested fields.

One of the most effective methods of treatment is the use of calomel-gypsum dust. Such a dust, containing eight percent calomel, may be dusted on the roots and stems of the plants as they are set. This treatment, if properly carried out, should pre-

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vent serious damage in the field. The alternate method is the use of *four percent calomel with gypsum,* dusted on the surface of the ground about May 5 and again in 10 days. It has been suggested that the treatment is usually necessary at about the time sweet cherries are in bloom. It is necessary to apply the treatment before the maggots injure the plants. When the plants begin to wilt it is usually too late to save them.

Cabbage Worms. Three species of cabbage worms commonly attack cabbage, cauliflower and related crops. These are the imported cabbage worm, the cabbage looper and the diamond-back moth. All attack the plants as caterpillars, feeding on the leaves, and at times each may become abundant and troublesome.

The control measure formerly used consisted of a calcium arsenate dust (one pound calcium arsenate and nine pounds of hydrated lime). This remedy is very effective but if used when the plant is nearly mature, leaves a poisonous residue. Many growers have found that *rotenone dust* (containing at least 0.75 percent rotenone) is effective in controlling these pests. According to some investigators, pyrethrum is more effective than rotenone in killing the cabbage looper. However, *rotenone dust* has given satisfactory results in most tests. The dust should be applied while the caterpillars are small, and about 20 pounds are required to treat an acre. In ordinary seasons, two applications should control these pests.

Striped Cucumber Beetle. The adult beetle attacks the leaves of squash, cucumber, pumpkin and watermelon plants, and causes most of its damage by killing the seedlings soon after they appear above the ground. The white larvae of the cucumber beetle feed on the roots of the host plants. Moreover, the adults may transfer wilt from one plant to another.

The beetles hibernate over the winter in debris in and around infested fields. In the spring they feed on wild plants until cultivated cucurbits are up. Then they migrate to the seedlings in large numbers and feed voraciously for several days. Most growers lose a part of their crop every spring due to the ravages of this pest. The beetles appear in such large numbers that prompt action is necessary to protect the plants. The best rule is to watch the seedlings daily until the first beetle appears and then start dusting at once. Two or three applications at weekly intervals should be sufficient for the entire season.

The most satisfactory material for cucumber beetle control is a *rotenone dust* (containing at least

0.6 percent rotenone).

Sometimes weather conditions are such that a crust forms on the surface of the ground and the pressure of the growing seedlings causes cracking. If cucumber beetles are abundant, they frequently crawl into these cracks and destroy the seedlings. This condition may be avoided by use of a weeder or light harrow to break the surface crust just before the seedlings come up.

The Mexican bean beetle became a serious pest in the East in the period between 1927 and 1932. It attacks string, lima and horticultural beans and in many regions causes serious damage to the crop. Both larvae and adults feed freely on the under side of bean foliage and both will attack bean pods if foliage is scarce. Their feeding causes a marked decrease in yield and in heavy infestations serious damage to the pods as well.

The adult bean beetles hibernate over the winter and attack beans late in May. The first generation of larvae feeds during the last half of June and the first half of July. First generation adults emerge late in July and during August. The second generation of larvae feeds during August and September and adults appear late in September and in October.

Any dust containing at least 0.5 percent rotenone should be satisfactory for bean beetle control. The first application should be made after the over-wintering adults appear. The second application is necessary as soon as the larvae begin to hatch. Mid-season beans usually require one treatment, about August 1. Late beans need treatment about August 1 and 12, and if the second generation is abundant a third application. Lima, horticultural and pole beans may require several treatments.

Two points in regard to application should be stressed. *All materials must be applied to the under surface of bean leaves in order to be effective.* Moreover, applications must be made before the larvae are full-grown in order to protect the crop. Many growers wait until the larvae are full-grown and the leaves are skeletonized before they apply an insecticide. Late application cannot be satisfactory and in many cases all of the damage has been done by this time. The best time for spraying or dusting is when the larvae are still small and little feeding has been done. Such early applications will entirely prevent feeding on bean pods.

The European Corn Borer. In the past few years the corn borer has done much damage to sweet corn, dahlias, and beets and has also attacked potatoes and rhubarb. Two generations occur each

year in this section of the country: the first maturing in July and damaging first early sweet corn, and the second feeding in August and September and hibernating over the winter.

Within the past two years the United States Department of Agriculture has completed development of both sprays and dusts to control the corn borer in sweet corn. The use of these insecticides is based on the fact that the young corn borer larvae feed for some time between the leaves of the growing whorl. If the spaces between these leaves are kept filled with toxic material, a large percentage of the larvae can be killed. The first treatment must be given as soon as the first eggs hatch and is followed by three other treatments at intervals of five days. All sprays and dusts are directed at the growing whorl of the main stalk and of each tiller. After tassels form the developing ears are sprayed or dusted.

Only first early corn, maturing in July, and late corn which has no tassels on August 1 have been treated profitably. It is suggested that growers who have infested fields treat only portions of the crop during the first season in order to become well acquainted with the procedure before attempting control on a large acreage.

The most satisfactory material for sprays has been pure ground derris or *cubé root* with a suitable spreader, which is usually added in processing, used at the rate of one pound in 25 gallons of water. The only effective dust material available is dual-fixed nicotine dust, a specially prepared material containing nicotine-bentonite and nicotine tannate, which is not the same as nicotine dust used for aphid control.

The most effective methods for applying both sprays and dusts have been by means of hand-operated sprayers and dusters. So far it has not been possible to treat the whorls using multiple-row power machines. The total cost of treatment varies from $20 to $30 an acre, depending on the rate of pay and the efficiency of individual men.

The suggested schedule for southern New England is as follows:

Crop	Approximate dates for sprays or dusts
First early corn (maturing in July)	June 5, 10, 15 and 20
Late corn (no tassels on August 1)	August 2, 7, 12, 17 and 22

Mineral Feeding Important

Condensed from Hog Breeder

Prof. C. N. Kinney

THE term "mineral," strictly speaking, refers to materials that make up the mineral kingdom, as compared to the vegetable and animal kingdoms. But the common usage of the term today, among dieticians, feed, and livestock men, is much broader and includes those chemical elements, both metal and non-metal, which are found to be utilized and which are required by the animal organisms in cell metabolism, or other life processes; and is, aside from fats, proteins, carbohyrates, and vitamins.

These required chemical elements are found in various forms of combination with other elements and may be present, at least in some cases, in the materials of either the mineral, vegetable or animal kingdoms. From whatever source they come, they are called "minerals." If found in the vegetable or animal feed products, they are generally spoken of as organic minerals.

When we speak of minerals, we really mean the chemical elements that make up the minerals. To illustrate: In soda there are four different kinds of chemical elements present, but it is only the one element sodium, in which we are especially interested in this case. So we think of this chemical element sodium, in the soda, as a mineral.

The relative efficiency, or degree of utilization, of the element in the animal body varies considerably, depending upon its form of combination with other elements. Some twenty-six chemical elements are now quite generally agreed upon as essential for animal life. Among some of the better known elements should be listed such chemical elements as iron, calcium, phosphorous, iodine, sulphur, sodium, potassium, chlorine, manganese, magnesium, copper, zinc, silicon, aluminum, etc., as well as carbon, hydrogen, oxygen and nitrogen, which make up the proteins, carbohydrates, fats and vitamins.

When we speak, therefore, of "mineral" in connection with feeds, we mean the chemical elements that are required for normal growth and maintenance of the animal body, in distinction from the complexes of proteins,

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carbohydrates, fats and vitamins. Whether they occur strictly in the mineral kingdom or not, they are still called "minerals."

It has been found that minerals seem to control and govern all the vital life processes of the animal body. In some mysterious way they play a fundamental part in all cell metabolism, govern the proper utilization of food materials and the elimination of waste products.

The fact that a minute amount of these minerals is all that is required in most instances, for life processes, only serves to obscure their importance The minute amounts of some of these elements escaped observation for a long time, largely on account of the fact that the analytical methods of detection of chemical elements of yesterday were not adequate to detect, or to estimate, the minute amounts present in a food material. Consequently their presence and vital importance was unknown. The present methods of detection were not developed until very recently, when the importance of minerals in nutrition was brought to light.

The question is so frequently heard: "Why are minerals now required as supplements for normal growth and development of farm animals; whereas formerly our fathers, in earlier frontier days, did not add minerals to the farm ration at all and, in fact, they were not even known of at that time?"

The answer is simple—the food material grown today on the very same farm is not of the same chemical composition that it was formerly, when grown on virgin soil. The food material is not of the same chemical composition as formerly, since the soil today is not of the same chemical composition that it was in earlier years.

The once fertile virgin soils have steadily become depleted by the leaching process on plowed lands, by rains and under drainage, and by crop removal.

A ton of alfalfa hay removes from the soil with each cutting, or cropping, some thirty to fifty pounds of lime. Then in approximately every eight to ten years, a ton of lime will be removed from each acre of soil and thus, on each quarter section farm, 160 tons of lime would be removed. Other minerals are removed in like proportion. Other elements which were present originally in much smaller amounts than lime would naturally disappear sooner. This mining, or draining of minerals from the soil, has been going on for years and many of the original mineral elements have, in many soils, almost entirely disappeared.

Plants must depend for their mineral food supply on the soil. Their composition and growth

will vary with the contents of the soil on which they are grown. Season conditions and methods of cultivation, etc., also affect plant growth and composition, but the major factor in plant composition is the soil condition and content.

It is known that southern grown wheat contains twice as much copper as northern grown wheat. Lettuce grown in California or Washington or Michigan is not of the same composition.

Plants grown in goiter belts are known to be deficient in iodine because the soil is deficient in iodine. Vegetation grown in phosphorous deficient areas is found to be low in phosphorous. Or, if the soil is low in iron or lime, the composition of the plants grown on that soil will be low in iron or lime.

With an impoverished, or exhausted soil, we grow an impoverished, defective food supply, on which defective food we raise a weak, sickly, slow growing unprofitable class of livestock.

The urgent need for a balanced mineral feed is quite evident. The subject of depleted soils and disappearing minerals is one of the most vital questions before the American public today. The question is one of enormous economic importance.

The experiments carried out by agricultural experiment stations, by government laboratories and by private research groups, as well as the results obtained by practical experienced stockmen, go to show that the feeding of minerals along with farm feeds, especially to stock consuming largely cereals, mill feeds, tankage and concentrates, is important.

If the primary cause of disease is due to faulty untrition, and the defects in a food supply are due to deficient minerals, then it is evident that the addition to the feed of proper supplemental minerals, when fed to strong, healthy, well animals, invariably results in continued healthy, normal nutrition.

A Mineral Mixture for Hogs

2 parts limestone dust
2 parts steamed bone meal
1 part common salt

The Sheep Scab Mite

Condensed from Sheep Breeder

Harold D. James

Ohio State University, Columbus, Ohio

SCABBIES in sheep, commonly known as sheep scab, is one of the oldest known, most contagious, and most injurious diseases affecting sheep. The condition is a highly contagious skin disease, easily transmitted from one sheep to another, and spreads very rapidly after being introduced into a flock. Although the disease is not hereditary, it is possible for a new born lamb to be infected from a diseased dam shortly after birth. There are several other varieties of scab affecting sheep, caused by a distinct species of mite.

Where allowed to spread, sheep scab causes great financial loss to the sheep industry. These losses may be enumerated as follows: A decrease in the quantity and quality of wool produced, loss in weight and general condition from irritation and other effects of the disease that renders the animals unthrifty, and the death of large numbers of infected sheep.

The mites which cause common sheep scab are small insect-like parasites known from the standpoint of veterinary parasitology as Psoroptes Communis Ovis. The male parasite when fully grown measures only about one fiftieth of an inch in length. The female parasite measures about one fortieth of an inch in length. The parasites are white in color and appear as small white objects upon microscopical examination. In making an examination a hand lens is highly beneficial. These parasites are found to occur on any portion of the body covered by wool, but are found most commonly in areas where the fleece is most dense.

The various stages in the life history of the scab mite are all passed on the body and in the fleece of the sheep. After mating of the sexes, the females deposit at least as many as 15 eggs, which hatch after 3 or 4 days incubation. The young mites grow to maturity in 7 or 8 days and in 3 or 4 days more mate and deposit their eggs. The females apparently live but a short time after they have laid their eggs. The entire life cycle has com-

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pletely been estimated to be that of a period of 12 to 15 days. It has been figured by a number of parasitologists that the sixth generation from one pair of mites which may appear in 90 days may consist of as many as a million and a half of parasites. This calculation should impress upon the sheep raiser the idea of the rapidity with which these parasites multiply. A few mites by gaining a foot hold on one or two sheep may in a short time have descendants enough to infest heavily the entire flock. The importance of prompt treatment when scab is discovered in a flock, or if sheep have been exposed to infestation is evident. Some of the points in the life history of the scab mite as mentioned above, have a certain bearing on the question of the time which should elapse in the treatment of sheep scab.

The mite or mites which cause common sheep scab are unable to propagate themselves except on the body and in the wool of sheep, their natural host. The mites of this species, however, when removed from the host, are able to live for some time. Various data that has been collected relative to this subject shows that mites removed from the body will commonly live from 2 to 3 weeks and cases have been recorded of their removal for as long as 2 months.

A dry atmosphere is very unfavorable to their existence away from the host. Other things being equal, scab mites will live longer off the body in a cool, moist atmosphere than in a warm dry one. It is fairly safe to assure that a month or two will suffice to free open pastures from infestation.

Buildings, pens, bedding grounds will not be safe even after a year or more. These places should be thoroughly cleaned and disinfected before they are used for non-infested sheep.

The symptoms of scab are made conspicuous by the movement and puncturing of the skin of the animal. Upon puncturing the skin by the mite, a slight inflammation is caused, made manifest by a reddening of the skin. As the parasites multiply, large numbers of punctures are made in the skin and are followed by intense itching with formation of small papules, inflammation and exudation of serum. The serum which oozes to the surface becomes mixed with the natural excretions and particles of dirt. The mass soon hardens into crusts or scabs in the wool thus giving to us the name of this parasitic disease under discussion. When the disease begins only a small pimple can be seen, but as the mites multiply these parasites seek the edges of the diseased area, and thus the lesion or scab

is continuously enlarged. The areas of the skin affected become hardened and thickened. When the affected skin is pinched or handled, the sheep as a rule turns its head toward the lesion, thrusts out the tongue, licks the lips and champs the jaws with an occasional bleat.

The intense itching causes the sheep to become restless. The animals bite, scratch, and rub themselves against any available object. The natural position of the wool is disturbed by their efforts to obtain relief. As the disease advances increasingly large areas become entirely denuded of wool. The skin finally become more or less bare, tumefied, is greatly thickened and may crack with bleeding as a result. Unless properly treated many of the animals will die.

For instructions as to treatment of this condition, your veterinarian should be consulted after a positive diagnosis has been made. The main object to be kept in mind is not to let the condition advance to a complete infestation of all the flock.

A Good Sheep Dip

8 Parts lump lime
24 parts powdered sulfur
100 parts water

Slake lime, mix with sulfur to a paste. Add water gradually. Boil two hours, renewing water to keep up to 100 parts. Let it settle and drain off the clear liquid. The sediment is very injurious to wool.—*Dr. W. A. Haines*

Many good commercial products are on the market.

Manganese Prevents Slipped Tendons

Condensed from Turkey World

J. Holmes Martin
University of Kentucky

THAT turkey poults are subject to slipped tendon or perosis has been shown experimentally. Perosis or slipped tendon is an enlargement of the hock joint, resulting in a twisting or bending of the "drumstick" at the lower end and a slipping of the tendon from its natural groove. The trouble was at first thought to be due to too much phosphorus or an improper calcium and phosphorus balance. Recent research has shown that perosis in chicks is due to a manganese deficiency. Unpublished results at the Kentucky Station indicate that the addition of 50 parts per million of manganese to a perosis-producing ration will prevent slipped tendons in turkeys; several cases having appeared in the lot receiving the basal ration.

Among the most potent "natural sources" of manganese are (1) alfalfa leaf meal, (2) wheat bran and middlings, (3) rice bran, (4) oat feed, and (5) green feed. If the starting ration contains liberal amounts of any one or all of these feeds, then there should be little doubt but what the ration will contain over 50 parts per million of manganese (an ample supply). If the ration is low in the first four and green feed is not available, then it would be wise to add one ounce of a technical (or anhydrous) grade of manganese sulphate to each 500 lbs. of mash. The manganese compound, which should first be pre-mixed with the salt, the ground limestone or bone meal, should not increase the cost of the mash more than 2 or 3 cents a sack.

Since at the Kentucky Station malformed (parrot beak) embryos and low hatchability resulted from a deficiency of manganese in the ration of Rhode Island Red hens, the turkey grower is safe in assuming that similar results would occur if his turkeys were on a manganese deficient diet. Hence, the same precautions should be taken with the breeder ration as with the starting feeds. Since wheat is about ten times as high as yellow

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corn in manganese and oats about half way between wheat and corn, wheat should be fed liberally, unless the mash is high in wheat by-products.

The most recent results of Gallup and Norris, at Cornell University, show that partial depletion of the bones of chicks in manganese "resulted in deformities at the joints and at the ends of the bones." They observe that, "It appears from these results that manganese in small amounts is a necessary constituent of bone in the chick and that it is essential for normal bone development."

Perhaps the deformed and crooked breastbones of turkeys have, in many cases, been due to the underlying cause of manganese deficiency. Too narrow roosts, too early roosting, and other environmental factors may have been only the immediate or aggravating cause. Some turkey breeders who never used crooked breast birds as breeders have reported a decided increase in crooked breastbones in drought years. This may have been due to the lack of green feed (a high manganese feed) to supplement a ration already too low in manganese.

The approximate manganese content of the more common ingredients is given herewith on the basis of yellow corn as 1.

Yellow corn (shelled or ground)	1
Corn gluten meal	1
Meat and bone meal	2
Barley (whole or ground)	3
Oats (whole or ground)	6
Rape	9½
Wheat	10
Bluegrass	10½
Alfalfa hay	13
Soybean hay	15½
Wheat bran	26
Wheat middlings (standard)	29

In simple terms, this table means that a turkey must eat 10 lbs. of yellow corn to receive the same amount of manganese contained in 1 lb. of wheat; or to put it another way 1/29 lb. (about ½ ounce) of wheat middlings would afford the turkey the same supply of manganese as 1 lb. of corn.

Concentration Markets for Perishables

Condensed from The Agricultural Situation

William C. Crow

CONCENTRATION markets for assembling fruits and vegetables are developing rapidly in producing areas, primarily because of the great increase in motortruck transportation during the last twenty years. In 1936 motortruck receipts accounted for approximately 44 percent of the fruit and vegetable supply of forty large cities.

Prior to about 1931 the use of the motortruck in bringing produce to large cities was limited chiefly to a radius of about 150 miles of the market; now produce is trucked from producing areas 400 to 500 miles, and in some cases 1,000 miles, to markets.

In 1931 about 95 percent of the supplies of fruits and vegetables coming into Philadelphia, from nearby States of New Jersey, Pennsylvania, Delaware, and Maryland, arrived by motortruck. A similar situation existed in New York.

From 1931 to 1937 truck receipts in the markets of New York and Philadelphia from nearby areas showed practically no increase, but from Virginia, North Carolina, South Carolina, Georgia, Alabama, and Florida receipts in 1937 were the equivalent of more than 10,000 carloads —more than four times the receipts in 1931.

Last year 74 percent of the shipments of fruits and vegetables from Virginia to Philadelphia were carried by truck—68 percent from North Carolina, 21 from South Carolina, 11 from Georgia, 9 from Florida, and 1 percent from Alabama. Figures for New York reveal a similar picture.

The expanding radius of operation of motortrucks has opened up larger markets for producers 400 to 500 miles (and to a lesser extent greater distances) from consuming centers. This development has contributed greatly to the expansion of fruit and vegetable production in areas where climate and soil conditions are favorable and production costs are relatively low. The expansion in some of the Southern States has been especially large.

To make the necessary adaptations in the marketing system to accommodate the advent of the truck, regional assembling or concentration markets have been established in many producing

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areas. These are markets at which fruits and vegetables produced within a radius of 50 miles or more are assembled for sale to merchant truckmen who come from a wide area to buy supplies.

These truckers' or farmers' markets have been established by State governments, private corporations, individuals, and cooperative associations. The State of New York has established a number of so-called "regional markets," New Jersey has its "country auctions," and Georgia and Florida each have a system of State-owned "wholesale farmers' markets."

While these markets vary as to type of location, layout, and method of operation, a description of one of the more successful markets in the Florida system will illustrate this type of market.

The Sanford State Farmers' Wholesale Market was established in 1935. The market covers 20 acres of land located on a railroad siding a few blocks from the business section of Sanford. Underneath the shed is a platform 35 feet wide built at the height of truck beds. This leaves 15 feet of overhanging roof to cover the trucks as they stand at the platform. This platform is divided into stalls with a floor space 35 feet deep and 22 feet wide.

In the Sanford market most of these stalls are rented to dealers who buy from the local farmers and sell to the truckmen from all parts of the country, but any farmer may sell his own produce on the market. In some of the other Florida markets the farmers rent the stalls and sell their own produce, and in still others the produce is sold at auction with the market manager serving as auctioneer.

The principal commodities handled on the Sanford market are beans, cabbage, celery, citrus fruits, potatoes, and tomatoes.

During a recent year more than 50 different kinds of fruits and vegetables were handled on this market. Since most of the truck buyers prefer mixed loads it is necessary for the market to have available at all times as complete an assortment of salable merchandise as it is possible to assemble.

About 95 percent of the supplies received on the Sanford market comes from 25 Florida counties, but a large proportion comes from within 50 miles of the market. Within about a 30-mile radius farmers usually bring in their own produce while dealers on the market usually send out trucks to bring in supplies from outside this 30-mile radius.

The annual volume of business transacted on the market is the equivalent of about 1,200 carloads.

During a recent season produce sold on the Sanford market was distributed (almost entirely by truck) to 26 States and Canadian Provinces. It is estimated that 95 percent of the sales go outside the State of Florida. By far the greater part of the merchandise distributed by these truck buyers goes to produce merchants or retail stores in the smaller cities and towns rather than into the large city terminal markets.

The Sanford market is illustrative of the many concentration markets rapidly being developed in producing areas primarily to adapt conditions to the use of the motortruck. To guide the development of such markets it is important that some study be made to assist in deciding for a region how many such markets there should be, where they should be located, what equipment is needed, how the market should be arranged and operated, and in answering other questions of a similar nature. The satisfactory development of markets of this type as concentration points in producing areas will adapt that part of the marketing system to the truck.

While these concentration markets are developing in producing areas, comparable changes are not being made to take care of the truck in the wholesale markets of large cities.

This, possibly, is a part of the reason why trucks from producing regions so often avoid the large city markets and go direct to the smaller cities and towns.

The motortruck is apparently here to stay; the marketing system must be changed to accommodate the truck not only at the producing end but also in the large consuming centers.

Pigs, Pasture and Protein

1200 Hogmen Study at Illinois Swine Day

Condensed from The Prairie Farmer

Joe Bumgarner

CHEERED by the favorable feeding ratio for hogs, 1200 Illinois farmers gathered at South Farm, March 31, to learn the latest results from the college's experimental swine work.

At a time when home pastures were just greening and still too soft to turn into, visitors were amazed to find spring pigs on South Farm tunneling through rye pasture higher than their heads.

Illinois is using two systems of rye pasture in experiments to find methods of cutting pork production costs by lengthening the pasture season. One consists of winter rye into which bred sows are turned following the regular pasture season in the fall to remain during the gestation period. The other is for handling sows with spring litters up to weaning time with the least trouble and expense.

Reporting on the use of winter rye pasture for brood sows, Wise Burroughs, assistant in animal husbandry, reported that the fall sown rye furnished six to eight weeks pasture following the regular grazing season last fall. Comparing the feed consumed by college sows wintered on the rye pasture with check lots in dry lot, Burroughs said that the sows on pasture harvested on an acre basis the equivalent of 528 pounds of alfalfa hay, five bushels of corn and 30 pounds of protein supplement.

Even more spectacular are the results of rye pasture seeded in the fall and kept free until sows are put on it to farrow pigs in the spring. One acre of rye pasture proved adequate for 100 sows and pigs. They are placed on the rye six weeks earlier than legumes are ready for pasture. If they are removed early in June the rye can be plowed under and the lot plowed and seeded to soybeans for a crop the same year and more rye pasture the coming fall. From the rye pasture, pigs are weaned and placed on more permanent clover and legume pasture which has been saved from being torn up by sows and pigs early in the spring.

B. W. Fairbanks, acting head of the swine department, reported that in addition to protecting baby pigs from dry-lot

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hazards of worms and disease the rye pasture plus a protein supplement produced gains with much less corn than was required with protein supplement on dry ice.

For each 100 pounds of gain, sows and pigs on rye pasture with protein supplement consumed 436 pounds of feed, whereas on dry lot it required 1027 pounds of the same feed to produce 100 pounds gain. Fairbanks warned, however, that rye is not a legume and is no substitute for protein supplement. When the supplement was omitted sows and pigs on only rye pasture and shelled corn consumed 1509 pounds of feed for each 100 pounds gain.

On bluegrass pasture, too, experiments showed that supplement was essential. Fairbanks said that sows suckling pigs on bluegrass pasture and receiving no supplement lost 30 pounds per head during the 40 day test period while their pigs gained only 17 pounds per head. The sows receiving protein supplement on bluegrass gained 46 pounds per head and their pigs each gained 26 pounds.

Switching from methods of producing larger and better litters to problems in fattening market hogs Burroughs made a progress report on experiments still underway to determine the optimum amounts of protein to feed growing-fattening pigs of different weights in dry lot.

Burroughs said conclusions to date indicate that for 50 to 75-pound pigs in dry lot the optimum per cent of protein in the ration appears to lie between 16.5 and 21. The 16.5 per cent protein ration was definitely too low, and adding protein above 21 per cent had very little value.

"For 75 to 100-pound pigs in dry lot," he said, "16 per cent protein or less seems sufficient. The 20 per cent ration was no better than the 16 per cent, and the 11 per cent ration was certainly too low.

"The data thus far obtained for hogs weighing 100 to 150 pounds indicate that protein up to 16 or 17 per cent in the ration can be profitably utilized, although the data are not conclusive in showing that a still higher level might be ultilized even better. This, however, is unlikely in the light of the previous test with 75 to 100-pound hogs.

"In the final period with 150 to 300-pound hogs the results were not uniform enough to draw any tentative conclusions. Nevertheless, it appears quite certain that less protein is required than for the pigs weighing 100 to 150 pounds."

Burroughs pointed out that this is a progress report and the conclusions are only tentative, and therefore should not be taken as final.

In a talk bristling with new facts Prof. Paul Gerlaugh, of the Ohio experiment station, packed much practical information for hogmen into his address. "But remember that as we speed up seasons and rate of growth we need more minerals and vitamins. Many fattening feeds are low in calcium, phosphorous, potassium and in some regions in iodine. Feed a mineral mixture."

Of protein supplement Gerlaugh said, "Liver meal has worked wonders for us. It comes nearest substituting for pasture for fall pigs of anything we know . . . 1 per cent milk products is a good investment until pigs reach 120 to 150 pounds. Iron ties up the dangerous properties of cottonseed meal, keeps it from affecting the blood stream. Cottonseed meal is perfectly safe for hogs provided it is fed half in half with tankage which contains iron from lean meat and blood."

In the first scientific answer to the argument raging over the feeding value of hybrid corn, Gerlaugh told of three trials with hybrid for hogs at the Wooster station. "In three different tests using adapted hybrid and open pollinated varieties two favored the open pollinated, one the hybrid. Significant that the hybrid excelled where it was raised on land known to be high in nitrogen and that in all cases hybrid outyielded open pollinated in the field. Conclusion . . . If we are going to grow hybrid corn we must improve cultural practices. More yields take more nitrogen. If the nitrogen is not in the soil the protein will not be in the grain. Add nitrogen fertilizer where needed and hybrid corn is equal of any in feeding quality."

Ventilation for the Poultry House

Condensed from The Poultry Item

C. E. Lee

A few years ago many poultrymen and most State Colleges took the position that no special system of ventilation was necessary in poultry houses. The open front was supposed to do it all.

The push for better ventilation came jointly from the poultryman who was dissatisfied with conditions in his laying houses during the winter and from certain commercial concerns who were engaged in the design and manufacture of ventilation systems.

A great variety of types and systems of ventilation have been designed.

In this discussion, however, we

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are going to stick to the insulated house. This narrows our field a great deal for the problem of proper ventilation is greatly simplified where the poultry house is properly insulated. It is often very difficult to ventilate an uninsulated poultry house satisfactorily, particularly in cold weather.

Ventilation is the movement of air through a building. A ventilating system cannot also function efficiently as a moisture remover unless there is enough heat accumulated in the building to allow proper expansion of the incoming cold air, thereby enabling this air to pick up moisture and carry it out of the building.

Furthermore, it is impossible to eliminate condensation on the walls and ceiling if there is too much temperature difference between the surface of the wall and the air in the room.

We can see, therefore, that moisture in the litter or on inside surfaces of the building must be picked up by the air. In other words, it must be evaporated as a direct result of the animal or auxiliary heat before it can be carried out of the room or pen through the ventilating system.

Prof. F. L. Fairbanks of Cornell University estimates the amount of heat given off by the birds in a 20′ x 20′ laying pen as about 2500 British thermal units per hour.

Part of this heat from the birds leaks out through the walls, ceiling, and windows or other openings. In an uninsulated laying house 20′ x 20′ size, the loss of heat through the ceiling alone, when the temperature in the house is 10° higher than the temperature outdoors, is about 2000 B. t. u. per hour, so that four-fifths of the heat produced by our birds is immediately lost through the ceiling regardless of losses that may occur elsewhere.

As a matter of fact, several ventilation engineers who have studied the problem extensively believe that approximately 40 per cent of the heat loss in the average laying house, during the winter, is through the roof. The north side is also important, but the big loss occurs through the ceiling.

Some authorities suggest that a 1-inch matched ceiling be installed on the inside of the rafters and moisture-resisting insulation placed between this and the roof. The heat loss then is reduced from 2000 B. t. u. per hour down to about 350 B. t. u.

Insulation is directly tied up with ventilation by reason of the necessity to conserve heat in order to get satisfactory moisture removal.

Some ventilation systems are so designed that the heat produced by the birds is removed through a ceiling outlet just

about as fast as the birds produce it. Such a system may give the birds plenty of fresh air, but it is also very likely to result in frosted combs, frozen water fountains, and greatly lowered production during extremely cold weather.

Actually, getting rid of moisture is perhaps our biggest job in keeping the birds healthy and in normal production.

The moisture given off by birds in the droppings is considerable, but is very much less than the moisture given off through the breath. Somewhat less moisture is given off in winter than in summer, as the consumption of water is lower per bird in cool weather. The amount given off per 100 laying hens per day seems to be between 3 and 4 gallons.

The moisture absorption of the air will vary so widely with the difference in temperature, and the relative humidity of the incoming air, that wide allowances must be made. Furthermore, we are also concerned with the necessity of a supply of oxygen to the birds that will be adequate.

It is easy to recognize when ventilation is insufficient or inefficient in removing moisture in the house. Condensation on the inside of the glass windows, dampness in the litter, dampness on the backs of the birds which may sometimes be felt when the birds are on the perches at night, are easy to recognize. It is not so easy to detect a deficiency in oxygen supply.

It is not at all necessary to argue about the necessity of plenty of fresh air for the health of the human species. What is not always recognized is the necessity for far more ventilation per 100 lbs. of live weight, where chickens are concerned, because of the higher temperature of the bird, their more rapid respiration, and therefore their far greater oxygen requirements in proportion to their size and weight.

The amount of ventilation required to maintain air in the poultry house at or near the degree of purity desired was studied in detail by the late Prof. F. H. King, the famous originator of the King System of Ventilation so widely used in dairy barns. Prof. King gave the circulation standards for various type of farm animals as follows:

Per horse	4290 cubic feet of air per hour
Per cow	3540 cubic feet of air per hour
Per hog	1340 cubic feet of air per hour
Per hen	35 cubic feet of air per hour

When we reflect that the average cow probably weighs around 1000 lbs. and the average hen about 4 lbs. it would seem that a cow ought to require 250 times as much air as the hen, but we see the table provides for only about 100 times. In other words, the requirements of the hen actu-

ally run some 2½ times the requirements of the cow.

Robert H. Hall in a paper read at the Harper-Adams Conference in England (1936) reported a series of experiments on poultry house ventilation in the course of which a record was kept of the weight of the birds, the number of eggs laid, the consumption of feed, and the volume of air passing through the pen.

Hall reported that their records showed that the ideal results were obtained by changing the air 8 times per hour. If we take a pen 20 feet deep and 15 feet wide, containing 300 square feet, this should be sufficient for 100 Leghorns. If we have a 7-foot ceiling this pen will contain 2100 cubic feet, approximately (not allowing for downward slant in the ceiling at the rear of the house). If we change the air in this pen 8 times per hour we will pass through it 16,800 cubic feet.

It seems that the standard set by Mr. Hall of 8 air changes per hour would give us sufficient assurance of good moisture removal in addition to satisfactory purity of the air, while certainly it is extremely liberal compared with the 3500 cubic feet per hour that would be required to meet the standard set by Prof. King.

The difference between Prof. King's 3500 cubic feet per hour per 100 birds, and the 16,800 cubic feet given in Mr. Hall's recommendations illustrate the wide variation in ideas of different authorities and investigators on ventilation. It may be explained by the more humid air of England and the fact that it takes more of such air to carry off the moisture in a pen.

There is probably no conclusive data on the effect of various relative humidities in a laying pen, but in experiments with birds in laying batteries there has been some indication that the most favorable humidity is around 45 to 50 percent.

In practice, there is no great danger of too low humidity except where some artificial heat is supplied, then there may be definite danger of a lack of moisture in the air.

During the winter in central New York, the humidity of outside air is frequently down to around 30 to 35 percent relative humidity, while in summer it may rise to between 80 and 90 percent quite frequently. However, in summer we have the houses quite open, and while there may be too much humidity, there is no danger of too little. In winter, with a low outside humidity, there would be some danger of the humidity being too low inside the house if artificial heat is used, but where artificial heat is not used, the low humidity of the incoming air is made up for by the added moisture from

the birds so that again there is seldom any danger of having humidity too low under natural conditions.

During the past ten years we have done considerable experimenting with various systems of ventilation and have taken note of the advantages and disadvantages of different types with the result that we have standardized on a flue system of ventilation with the flue coming down to within 15 or 18 inches of the floor of the house and being placed at the back wall, or in other words, with the out-take flue on the opposite side of the house from the intake, insuring movement of air throughout every part of the house and consistent movement always in the same direction.

Prof. E. R. Gross, of the New Jersey Agricultural Experiment Station, in circular No. 306 describes a practically identical system which they are recommending for poultry houses in New Jersey. Prof. Gross says: "An out-take flue, opening 1½ to 2 feet above the floor, is recommended rather than one opening near the ceiling, as this increases the height and thereby the flow of air. It draws the colder air from the floor thus conserving the heat in the house while only slightly reducing the temperature differential. It is necessary to remove a large volume of air in order to control humidity. This must be regulated by the size of the flue since temperature and height are not so readily changed. The cross-sectional flue areas should not be less than 2½ square inches per bird for one story houses. Larger flues are often desirous. Thus, the New Jersey 20′ x 20′ unit for laying birds requires a 16″ x 16″ flue, and the 20′ x 24′ unit requires the 16″ x 20″ flue, inside measurement. For brooding, battery laying, incubating or other uses, allow ¾ of a square inch of flue area for each square foot of floor space."

Prof. F. L. Fairbanks, of the Agricultural Engineering Department, Cornell University, gives the following specifications for a satisfactory system—

"No. 1. For winter weather of about 15° F. the following is required if control of the temperature is to be obtained: The usual outside wall construction, single-board and roofing or double-board and paper, 4 inches to 6 inches of loose insulation, ceiling on the inside of the studs and rafters, tight storm windows and a floor out-take ventilation system."

In all essentials both the New Jersey and the Cornell floor out-take flue system are identical with the Swarthout system which we have used at the Research Farm since 1928.

In this system the air is brought in through a cold air box at the front of the house, or through windows or other openings. The cold air should preferably be brought in at a point 2 or 3 feet off the floor, and a baffle board should be arranged so that there will not be any objectionable draft on the birds.

The incoming air flows gradually back from the front, across the surface of the litter, and mixes with the heated air given off from the birds. The heat given off by the birds causes the air to rise, forming an upward current, while the air along the surface of the walls and the windows, where heat is lost by the air quite rapidly, moves downward and causes a rolling motion which helps to keep the air in the pens well mixed.

The temperature at the ceiling has, however, been found to be consistently higher where this system of ventilation is used than the temperature at the floor so that taking the air out at floor level removes the colder and heavier air and with it a large proportion of the carbon dioxide and moisture.

There is some difference in the size of flues recommended as between the New Jersey and Cornell plans and the Swarthout system used by us. However, the differences are really small since our measurements are given in diameter of the throat of the (rotary or monitor type) ventilator. The base of this ventilator is larger than the throat diameter, and the exact size of flue required will vary somewhat with the make of monitor ventilator used. For example; in one make of frost-proof monitor type ventilator of 12″ throat diameter, the base is 16 inches square and this size of tube conforms to the Cornell and New Jersey recommendations as well as with the Swarthout specifications given below. Any slight differences in the other sizes are not of consequence. It is important to keep in mind that the make of ventilator to be used and the size of the base of the ventilator must be determined before the tubes are constructed.

Table 2

Conservative Air Rating

Rotary (Monitor) Ball-Bearing Ventilators

Size (Inches)	Cubic Feet of Air Per Minute
12	275
14	370
16	490
18	650
20	800
24	1100
30	1700
42	3400

Table 3

Ventilator Requirements

Up to 20′ deep	one 12″ Rotary Ventilator
21′ to 24′	one 14″ Rotary Ventilator
25′ to 30′	one 16″ Rotary Ventilator

The figures below are based on the proven performances of efficient ball-bearing Monitor type ventilators. They are not applicable for any other less efficient type of ventilator.

Shed or Shed and Lean-to Roof Types, use for each 400 sq. ft. of floor area—

Up to 20′ deep	one 14″ Rotary Ventilator
21′ to 24′	one 16″ Rotary Ventilator
25′ to 30′	one 18″ Rotary Ventilator

Double-Pitch Roof (where ceiling extends to rafters), use for each 400 sq. ft. of floor space—

We prefer an out-take tube which opens not more than 18″ above the floor and not less than 12″ above the floor. This conserves a greater amount of heat and keeps the moving air down near the litter at the back which improves the performance of the system so far as keeping the litter dry is concerned.

Damper Handle

A short distance above the bottom opening of the out-take flue there should be installed an adjustable flap damper with an operating handle extending out beyond the dropping board. Instead of a flap damper, a straight piece of board sliding through a slot in the side of the flue may be used. At any rate, a damper should be provided near the bottom of the duct, together with an adjustable opening at the ceiling. In the summer, or in warm climates throughout the year, the upper damper should be wide open and the bottom damper about half open. In the winter time, in cold climates, the upper outlet should be kept absolutely closed and the bottom one full open, the amount of air passing through the pen being regulated by manipulation of the intakes.

In a multiple-story house the same system is used, the only change necessary being the use of adjoining ducts for each floor, each duct being kept absolutely separate until it leads into the base at the roof. The roof stack may be capped with one monitor type ventilator instead of running separate stacks capped with individual ventilators for each floor, but the ducts must be kept separate until they run into the base underneath the metal ventilator.

In a multiple-story house, after establishing the size of duct to be used for each pen or each floor, the duct should be built from the first floor to the roof. If a square or rectangular duct is used it will only be necessary to build three sides of the second floor duct as the first floor duct will provide the fourth side.

With the out-take flues located at the back wall of the house, as in the Swarthout and New Jersey plans, many poultrymen may figure that it is easier to put the flue on the outside of the house and cut openings into it from the

inside of the pen. This does not give satisfactory performance as the air is cooled too rapidly in the flue. If such a system is used it would be necessary to use a very expensive program of insulating the flue, whereas, by keeping the flue inside the pen, the air ascending in the out-take flue is kept reasonably warm until it goes out of the ventilator.

The bottom of the ventilator itself should preferably be at least a foot or two above the highest point of the roof, and in locations where over-hanging trees are nearby or other obstacles prevent the most satisfactory air movement outside the house, it is well to extend the out-take flues for some distance above the roof, in which case they should be insulated with at least 4 inches of sawdust, shavings, or other good insulating material.

Home-made ventilator caps, as shown in the New Jersey and Cornell specifications, can be used at some saving in cost, but it is our opinion that a well designed, ball-bearing monitor type of commercial metal ventilator is much to be preferred. The monitor type ventilator always faces away from the wind and some studies have shown about 40% increase in capacity as compared with the stationary ventilator. Furthermore, no back draft is possible because the monitor type ventilator swings around so as to face directly away from the wind. Where a stationary ventilator is used, it is usually necessary to install a butterfly anti-back-draft damper to prevent back-drafts under certain air conditions.

The monitor type ventilator has another advantage in that it does not admit rain or snow to the ventilator shaft.

The air-intakes should be located in the front of the house and be placed so that there is even distribution of the incoming air all over and across the house. The total intake area must not exceed the area of the out-takes. Larger out-takes interfere with the proper performance of the ventilating system by allowing counter air movements and by decreasing the temperature differential between the inside and outside air.

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